# 1NC

## 1NC---Oil

#### Contention one is oil.

#### Multiple indicators confirm the economy is stable despite market uncertainty---pessimistic predictions are driven by politics and not empirics.

Matthew Fox, 3-26-2025, "Stagflation fears are rising. Here's why one firm says it's an unlikely outcome for the economy.", archive.ph, <https://archive.ph/1p6er> [Matt covers macro research and stock market news at Markets Insider. He contributes to the markets and investing teams. Previously, Matt worked as an investment research analyst and equity portfolio manager at a +wealth management firm. Matt started his career as a financial reporter at theflyonthewall. Matt joined Insider in April 2020 and is a Chartered Market Technician (CMT).] DOA: 3/29/2025

Fears of stagflation hitting the US economy are rising. The dire economic scenario, in which inflation rises while economic growth deteriorates and unemployment surges, would be a flashback to the 1970s for America. That time period proved to be a brutal lost decade for the US stock market. But Sonu Varghese, global macro strategist at Carson Group, sees little risk of stagflation occurring anytime soon. "Folks, we are far from stagflation," Varghese said in a recent note. Inflation concerns are overblown Consumer sentiment has soured since President Donald Trump's inauguration in January, partly because of concerns that tariffs will drive a rebound in inflation. However, Varghese says that higher inflation expectations among consumers are more of an expression of political dissatisfaction than a view of actual economic conditions. "The increase in inflation expectations would typically be very concerning for the Federal Reserve, but other surveys don't show a similar surge," Varghese said, pointing to the New York Federal Reserve's consumer survey and the Atlanta Fed's business expectations survey. In addition, wage growth, a key inflationary pressure, is hovering near pre-pandemic trends that were consistent with low inflation. Annualized wages rose 3.6% for all private workers over the past three months, compared to the pre-pandemic trend of 3.1%. "Forget stagflationary levels of inflation, this pace of wage growth is consistent with 2% inflation," Varghese said in a recent note. Oil isn't moving higher One of the big shocks of the stagflation crisis in the 1970s was surging oil prices. "Energy price shocks tend to drive upside inflation shocks and right now, we don't have anything close to that," Varghese said. That's not happening now. At just below $70 a barrel, US crude oil is trading at levels last seen in 2018. WTI Crude Oil prices since 2018 Oil prices are trading near their 7-year average of $68.34 oil price chart WTI Crude Oil, weekly closing prices Average oil price since 2018 2019 2020 2021 2022 2023 2024 2025 0 20 40 60 80 100 $120 Covid pandemic sends oil prices plunging Oil prices surge after russia invades ukraine Source: Bloomberg Matt Fox/BI With US oil production near record levels and OPEC scaling back its production cuts, there's no sign that oil prices will surge in the near future. The labor market is holding up While there's been a slowdown in hiring, partially driven by the uncertainty coming out of Washington, D.C., the unemployment rate is essentially at a standstill at about 4.1%, which is historically low. Related stories Stagflation can be worse than recession. Investors are already bracing for it. Recession alarms are ringing on Wall Street. Here are 4 warnings economists are pointing to. "Overall layoffs are running lower than where they were before the pandemic, and even if you normalize for the large workforce we have now, the 'layoff rate' is 1%, below the 1.2-1.3% range we saw prior to the pandemic," Varghese explained. While the data can always change, and DOGE is fueling fears of future labor-market weakness, there are no signs that stagflation is on the horizon, Varghese said.

#### But, increased investment in net-zero emissions kills the oil industry.

IEA, 11-xx-2023, "The Oil and Gas Industry in Net Zero Transitions – Analysis", IEA, <https://www.iea.org/reports/the-oil-and-gas-industry-in-net-zero-transitions> [Since 2015, the IEA has opened its doors to major emerging countries to expand its global impact, and deepen cooperation in energy security, data and statistics, energy policy analysis, energy efficiency, and the growing use of clean energy technologies.] DOA: 3/22/2025 //RRM

* NZE = Net Zero

The smaller opportunity for exports causes international oil and gas prices to fall and a number of export-oriented producers are forced to reduce production.4 In 2040, a 4 mb/d reduction in production by exporters would mean the oil price for exporters would fall to around USD 20/barrel in 2040. OPEC’s share of the oil market in this case is 39% in 2040 and 41% in 2050, much lower than the levels seen in the NZE Scenario (44% in 2040 and 51% in 2050). This case would see a major fragmentation of international oil and gas markets. Importers choose to forego cheap oil and gas available on the market to protect their domestic oil and gas industry. The overall cost for oil and gas supply is also much higher than in the NZE Scenario. To 2050, cumulative capital and operating costsfor oil and gas supply is around USD 1 500 billion higher than in the NZE Scenario (a 25% increase). This case also includes some potential policy inconsistencies, with importers looking to protect – or even subsidise – domestic oil and gas companies even as they rapidly scale up clean energy investment and move away from fossil fuel use. 4 High-cost exporters are assumed only to reduce production designated for export so that they can always meet their own consumption with domestic production to avoid becoming net importers. Egypt India China Russia Saudi Arabia Canada -1.0 -0.5 0 0.5 1.0 1.5 Oil Africa Asia Pacific Eurasia Europe Middle East North America C & S America mb/d India China Russia Qatar United States Mexico -60 -30 0 30 60 90 Natural gas bcm IEA. CC BY 4.0 Chapter 1 | Oil and gas in net zero transitions 57 1 Conclusions The cases examined here highlight that different supply pathways are possible in a net zero emissions world (Figure 1.28). In general they achieve their starting aims, but they also see major potential downsides for producers, markets and net zero transitions. Figure 1.28 ⊳ Differences in oil and gas production from the NZE Scenario in the sensitivity cases, 2040 IEA. CC BY 4.0. Changes in preferences can reshape oil and natural gas production across regions, but increases in one part of the world must be matched by faster declines elsewhere. Note: C & S America = Central and South America.  In the low-income preference case, oil and gas production in low-income countries is around 4.5 mb/d and 300 bcm higher in 2050 than in the NZE Scenario. But in the context of oil and gas prices in the NZE Scenario, many of these new projects would fail to generate a reasonable return and could become stranded assets.  In the emissions preference case, emissions from oil and gas operations are reduced globally by around 200 Mt CO2-eq in 2030. But this reduction is much smaller and more expensive than the reduction in emissions in the NZE Scenario, in which producers undertake targeted action to reduce their emissions intensity and emissions are cut by 2 200 Mt CO2-eq in 2030.  In the cost preference case, the total cost of supplying oil and gas to 2050 is 7% lower than in the NZE Scenario. But this case sees a further concentration of production – already visible in the NZE Scenario – among a small number of countries, and so may lead to heightened security of supply concerns. This case also sees lower commodity prices than in NZE Scenario and some producer economies would likely struggle to withstand the impacts on their fiscal balances. - 6 - 3 0 3 6 Cost Emissions Low-income Energy security Oil mb/d bcm - 300 - 150 0 150 300 Natural gas Africa Asia Pacific Europe Eurasia Middle East North America C & S America Other IEA. CC BY 4.0 58 International Energy Agency | Special Report  In the security preference case, most countries successfully cut their reliance on imports, and global oil and gas imports in 2030 are around 20% lower than today (compared with a 13% drop in the NZE Scenario to 2030). But achieving this would lead to a major fragmentation of international oil and gas markets, and means the cost of supplying oil and gas is around 25% greater than in the NZE Scenario to 2050. A key assumption in the sensitivity cases is that overall demand levels do not change, with increases in production above the levels in the NZE Scenario by some countries matched by an identical level of reductions by others. Commodity prices could be the intermediary to allow for this, with new developments in one part of the world leading to lower prices and reductions in production in other parts of the world. Avoiding an increase in demand, however, may require policies to be further tightened above what already occurs in the NZE Scenario and there is a risk that this would not happen. Some of the cases examined would also imply a breakdown in international oil and gas markets as they are today, and it is not clear if prices would send a clear enough signal to avoid overproduction. Figure 1.29 ⊳ Selected security, cost and revenue indicators in the NZE Scenario and supply-side sensitivity cases IEA. CC BY 4.0. The cases examined involve trade-offs between security, cost and oil and gas revenue in low-income countries. The NZE Scenario aims to chart a middle ground between these. A world with rapidly declining oil and gas demand will inevitably involve trade-offs and compromises for producers and consumers between cost, security, emissions and equity concerns. In the NZE Scenario, the supply-side dynamics are based on the assumption that there is no development of new long lead time upstream conventional projects and that prices rapidly fall to the operating costs of the marginal project. While there is no single answer, this assumption means the NZE Scenario charts a middle ground between a number of the various trade-offs that exist (Figure 1.29). 1 2 3 4 Trillion USD (2022) Cumulative revenue in low income countries to 2050 NZE Low-income Emissions Cost Security 150 200 250 300 Billion USD (2022) Annual average oil and gas investment to 2050 45% 50% 55% 60% OPEC share in 2050 IEA. CC BY 4.0 Chapter 1 | Oil and gas in net zero transitions 59 1 The above analysis focuses on the NZE Scenario, but many of the considerations also apply in the context of the APS. For example, in the APS, investment to reduce the emissions intensity of existing operations is still a more effective way to reduce GHG emissions than developing new fields. New conventional crude oil and gas developments are required in the APS, but with falling oil and gas demand there could still be intense competition for market share. Increases in production in one part of the world would likely require reductions elsewhere to avoid making the later stages of the transition even more challenging. All producers can make arguments as to why their resources should be developed over others. In net zero transitions new project developments are, however, likely to face major commercial risks. Producers looking to undertake new resource developments need to explain how their plans are viable within a global pathway to net zero emissions by 2050 and be transparent about how they plan to avoid pushing this goal out of reach. 1.7 Investment Total energy investment in 2023 is estimated to be USD 2.8 trillion. Of this, around USD 1.8 trillion will be invested in clean energy, and USD 1 trillion in oil, gas, and coal (including extraction, refining, transmission and distribution, and power plantsthat use these fuels). Both the APS and NZE Scenario see a major increase in clean energy investment, rising to USD 3.1 trillion in 2030 in the APS and to USD 4.2 trillion in the NZE Scenario (Figure 1.30). This boost in clean energy investment is the principal driver behind the drop in fossil fuel use that can be achieved while ensuring there is no shortfall in meeting energy service demands. Figure 1.30 ⊳ Investment in clean energy and fossil fuels by scenario IEA. CC BY 4.0. In the NZE Scenario annual fossil fuel investment drops by USD 500 billion to 2030 while clean energy investment increases by more than USD 2 trillion. Note: 2023e = estimated values for 2023. 1 2 3 4 5 2023e STEPS APS 2030 NZE 2023e STEPS APS 2030 NZE Power Supply End use Energy efficiency Coal Oil Natural gas Trillion USD (2022, MER) Clean energy Fossil fuels IEA. CC BY 4.0 60 International Energy Agency | Special Report In the APS, investment is needed in both new and existing oil and gas projects: oil and gas investment in 2030 is around USD 650 billion, around 20% less than the expected level in 2023 (Figure 1.31). In the NZE Scenario, investment shifts entirely to maintaining production at existing fields, and to reducing the emissions intensity of oil and gas operations. Investment in oil and gas supply falls to USD 400 billion in 2030, half of the level in 2023. In both the APS and the NZE Scenario, the increase in clean energy investment is assumed to be synchronised with the scaling back of investment in fossil fuels. In reality, mismatches in investment levels are likely, and both over- and underinvestment in oil and gas could have important consequences for net zero transitions. Figure 1.31 ⊳ Investment in new and existing fields by scenario IEA. CC BY 4.0. Investment in oil and natural gas supply declines from current levels in both the APS and NZE Scenario. Capital spending in the NZE Scenario is focused entirely on existing fields. 1.7.1 Risks from overinvestment Overinvestment could occur if the oil and gas industry invests for long-term growth in demand that does not materialise. This risk has always been a feature of oil and gas markets, but net zero transitions – and the prospect of long-term structural declines in oil and gas demand – would present a new and pervasive set of risks and uncertainties. In such a situation, oil and gas prices would fall and new projects would face major commercial risks and may fail to recover their upfront costs. Existing projects could be at risk if oil and gas prices remain below operating costs for a prolonged period. Moreover, it could lead to difficulties for producer economies in which oil and gas sales make up a significant share of exports and fiscal revenues. Overinvestment in supply also risks locking in emissions that could push the world over the 1.5 °C threshold. This could be avoided by governments adopting resilient policies that prevent a drop in prices feeding through into a rebound in oil and gas demand. But in practice 100 200 300 400 2023e 2030 2050 2030 2050 2023e 2030 2050 2030 2050 Oil Natural gas Oil Natural gas Billion USD (2022, MER) Exisiting fields: New fields: APS NZE APS NZE IEA. CC BY 4.0 Chapter 1 | Oil and gas in net zero transitions 61 1 this may be difficult to stop. Additional emissions from new projects would therefore need to be compensated by even more robust emission reductions in the latter years of our projections to achieve net zero emissions by 2050. Assessing the risks of stranded assets A reduction in oil and gas production and prices could lead to widespread losses for the oil and gas industry and to stranded assets. There are multiple strands to this debate and it is therefore useful to distinguish between different impacts and losses that could be incurred by the oil and gas industry. In particular, it is helpful to distinguish between:  Stranded volumes: existing fossil fuel reserves that are left unexploited as a result of climate policies.  Stranded capital: capital investment in fossil fuel infrastructure that is not recovered over the operating lifetime of the asset because of reduced demand or reduced prices resulting from climate policies.  Stranded value: a reduction in future revenue generated by an asset or asset owner, as assessed at a given point in time, caused by reduced demand or reduced prices resulting from climate policies. The world currently has around 1.8 trillion barrels of oil and 220 trillion m3 of natural gas 2P reserves. With reasonable assumptions on possible deployment rates of CCUS and negative emission technologies such as DACS and BECCS, a large proportion of these reserves cannot be combusted if the temperature rise is to be limited to well below 2 °C or 1.5 °C. For example, in the NZE Scenario around 30% of today’s oil and natural gas reserves are produced by 2050. However, this does not necessarily mean that large volumes of reserves will be “stranded”. In the STEPS, around half of oil and gas reserves are produced to 2050. In other words, a large amount of existing oil and gas reserves will not be used even under much higher temperature outcomes. There is undoubtedly a large difference in fossil fuel use between the scenarios, but the assessment of risks to the industry is better focused on investment and value losses rather than reserves. In the NZE Scenario, despite the sharp reductions in demand, the risk of stranded capital is relatively low as it is mitigated by production decline rates that are consistent with no further investment in new projects. Some fields are closed before the end of their technical lifetimes, but most of these projects will have recovered their upfront capital by the time shut-in risks appear. In the upstream sector, stranded capital risks therefore exist primarily in the form of the sunk costs incurred in exploring for resources that are not ultimately developed in the NZE Scenario; we estimate that this amounts to around USD 400 billion in total

#### And, it risks broader economic decline during the mid-transition period.

Etienne Espagne et al., 9-7-2023, "Cross-Border Risks of a Global Economy in Mid-Transition", IMF, <https://www.imf.org/en/Publications/WP/Issues/2023/09/08/Cross-Border-Risks-of-a-Global-Economy-in-Mid-Transition-538950> [Étienne Espagne is a senior climate economist at the World Bank EFI chief economist office and an associate researcher at CERDI. William Oman is an economist at the International Monetary Fund, where my work within the Monetary and Capital Markets Department focuses on climate- and nature-related financial risks, macro-finance, and central banking. Previously, I worked in the IMF's European Department and IMF Europe Office, where my responsibilities included surveillance on the euro area, France, Malta, and Spain, as well as IMF engagement with the OECD, the ECB, and the European Commission. Dr. Jean-Francois Mercure is Senior Economist at the World bank and Associate Professor in Climate Policy at the Global Systems Institute, University of Exeter, UK. Romain Svartzman completed his PhD in ecological macroeconomics at McGill University (Canada). He also holds a master’s degree in Finance from the Institut d’Etudes Politiques de Paris (Sciences Po) and a degree in Economics and Law of Climate Change from FLACSO Argentina. Ulrich Volz: MSc, PhD (FU Berlin). Hector Pollitt is a director and head of Modelling at Cambridge Econometrics, with extensive experience in the development and application of macroeconomic modelling tools for impact analysis. He holds overall responsibility for maintenance of CE’s global E3ME model. Gregor Semieniuk is an Assistant Professor of Public Policy and Economics. His research focuses on the energy and resource requirements of global economic growth and on the political economy of rapid, policy-induced structural change that is required for the transition to a low-carbon economy. Gregor has published on these topics including in Nature Climate Change and Nature Energy, consulted for the United Nations Environment Program, the European Commission and the UK government, and won grants to study policies inducing investments into renewable energy supply as well as the risks for financial investors from stranded assets in a fast low-carbon transition. He holds a Ph.D. in Economics from the New School for Social Research. Emanuale Campiglio: Associate Professor at the University of Bologna - Department of Economics Scientist at the RFF-CMCC European Institute on Economics and the Environment Visiting Fellow at the London School of Economics and Political Science - Grantham Research Institute] DOA: 3/27/2025 //RRM

A consistent analytical framework for the cross-border economic and financial risks associated with a world economy in this critical mid-transition period is needed.3 The existing literature on the macroeconomic effects of climate mitigation policies often simplifies nation-level challenges and policy contexts with the goal of seeking simple narratives that apply at the global level (Riahi et al., 2022; Masson-Delmotte et al., 2018; Van Vuuren et al., 2020; Rogelj et al., 2018; Grubler et al., 2018). Developed as general basis scenarios of globally coordinated decision-making and cost-effective economic evolution, this literature sheds little light on the links between the transition and the structural transformation of the global economy. While a growing body of literature examines the cross-border effects of the physical impacts of climate change, we are unaware of any systematic analysis of the cross-border impacts of decarbonization in a mid-transition context.4 The paper’s three main contributions are as follows. First, we draw on a range of stylized facts to show that global decarbonization will very likely change the structure of international trade and capital flows. Second, we propose an analytical framework to analyze these effects that is based on a system dynamics approach. Third, we assess a subset of the likely impacts of global decarbonization that we outline, notably those on output and trade, under specific global decarbonization assumptions. Our analysis suggests that, among the world’s largest economies, China, India and Japan are likely to benefit the most from the transition, while Russia, Saudi Arabia the U.S. could be negatively affected relative to a hypothetical baseline of baseline GDP growth. While this paper seeks to draw the attention of the research and policy communities to cross-border transition risks, it does not imply any minimization of the major opportunities associated with the transition – and the counterfactual of an absence of transition implies far greater risks than those we analyze here. Opportunities include economic growth, notably in the short run as low-carbon infrastructure is developed, as well as job creation, innovation, and many environmental and health co-benefits (see, e.g., Bhattacharya et al., 2021). A counterfactual “no (or failed) transition” scenario, where fossil production and consumption are not significantly reduced would imply a host of major cross-border risks, in particular those stemming from the economic and financial consequences of an accelerated deregulation and destabilization of the Earth system. The rest of this paper is organized as follows. Section 2 highlights several stylized facts that are relevant for assessing cross-border risks during the mid-transition period. Section 3 proposes a taxonomy of country-level cross-border risks. Section 4 analyzes potential cross-border impacts that result from shifting trade, energy, and employment patterns, quantifying some of them using the E3ME-FTT global macroeconomic model. Section 5 explores the potential international macroeconomic and financial spillovers that cross-border mid- 2 As documented by Fressoz (2022), the concept of “energy transition” first appeared in 1967 in response to the threat of energy resource shortages, and in 1982 to make the case for the need to invest in nuclear energy as a contingency option to rapidly decarbonize the global energy system if a climate catastrophe were to appear likely. Geels and Turnheim (2022), meanwhile, use the term “transition” to refer to a technological transformation that may not necessarily be entirely driven by a climate goal, making use of a historical perspective looking at where transitions have occurred before and the conducing factors. Here, the mid-transition that we describe does not necessarily imply a sufficiently rapid decarbonization of the world economy to avoid climate change of 2°C or more. 3 The paper essentially abstracts from the macroeconomic effects of physical risks of climate change, including those that could adversely impact the global low-carbon transition. 4 See the recent study by Carter et al. (2021) for a conceptual framework for cross-border impacts of the physical effects of climate change. On cross-border impacts of physical climate change, see also Adams et al. (2021), Benzie et al. (2019), Bailey and Wellesley (2017), Challinor et al. (2017, 2018), Hedlund et al. (2018), Otto et al. (2017), Schenker (2012), Smith et al. (2018), Volz et al. (2020), and Feng and Li (2021). Laybourn et al. (2023) argue that societal reactions to worsening physical climate impacts could create destructive dynamics whereby societies are increasingly distracted by the symptoms of the crisis, deepening its consequences and generating a doom loop. IMF WORKING PAPERS Cross-Border Risks of a Global Economy in Mid-Transition INTERNATIONAL MONETARY FUND 5 transition risks could cause. Section 6 provides a summary of the findings and concludes with reflections on the scope for future research. 2. Stylized Facts to Inform Mid-Transition CrossBorder Risk Analysis This section covers current technological and structural transformation trends, global macroeconomic and financial patterns observed in the recent past, and specific price dynamics that arise with mid-transition crossborder risk scenarios. 2.1. Stylized Facts for a Mid-transition Period The world economy could become exposed to higher uncertainty and instability as a result of the parallel emergence of low-carbon technologies and persistence of fossil-based infrastructures. These parallel and contradictory trends open a potentially lengthy mid-transition period, when the fossil-based energy system will coexist with the emerging low-carbon energy system, while being increasingly impacted by increasing climate damages. As noted in the introduction, we borrow the “mid-transition” term from Grubert and Hastings-Simon (2022). As these authors note, each energy system – the old and the emerging – imposes operational constraints on the other. This coexistence means that the emerging low-carbon energy system will face fossil system constraints. This “mid-transition” will therefore require “decision-making under dynamic and uncertain conditions.” There is a substantial low-carbon energy investment shortfall for reaching global average temperature objectives, with some estimates putting the clean energy shortfall at nearly US$3 trillion per year (IEA, 2022a), alongside a potential investment excess or shortfall in fossil systems (reflecting increasing market uncertainty and uncoordinated expectations). The potential for instability could therefore become considerable. During that period, as shown in Figure 1, different sources of instability and uncertainty are likely to materialize, with opposite effects on the transition. Figure 1. Stylized Representation of the Unstable Mid-Transition Period Note: Stylized view of the possible volatility and instability of paths for market shares of high- and low-carbon capital through the middle phase of a low-carbon economic transformation, as low-carbon industries rise rapidly concurrently to a high-carbon industry decline. IMF WORKING PAPERS Cross-Border Risks of a Global Economy in Mid-Transition INTERNATIONAL MONETARY FUND 6 The first key trend is that low-carbon technological change is underway, affecting conventional fossil markets. Technology data show that decarbonization is well underway in several key sectors and countries (power, transport in the EU and China) but only nascent in others (industry, heat; see IEA 2022b; Mercure et al., 2021). Established high-carbon systems and economic structures may be disrupted by ongoing low-carbon technological change and innovation (Tong et al., 2019). The transition towards low-carbon energy generation and use is a self-reinforcing process, in which deployment decreases costs, which facilitates further deployment (Way et al., 2022, Mercure 2012, Mercure et al., 2014, Arthur, 1994; Unruh, 2000). Tipping points past which diffusion becomes irreversible could be near or already past (Sharpe and Lenton, 2021), notably towards solar energy (Nijsse et al., 2023) and electric vehicles (Lam and Mercure, 2022). The prospect of a dominance of solar energy and electric vehicles has stark implications for the value of high-carbon assets (Semieniuk et al., 2022). Emerging market and developing economies (EMDEs) could become markets for low-carbon technologies even with limited government capacity to implement climate policies. Diminishing cost through broader adoption of these technologies could in turn mitigate the potentially negative current account effects for EMDEs of importing low-carbon technologies. In the longer run, the main cross-border risk from increasing renewables installation globally is a declining demand for and trade in fossil fuels, and the potential for stranded fossil assets and related capital and infrastructure, concurrent with increased trade in and declining costs of low-carbon technology.5 At the same time, the emergence of uncoordinated low-carbon industrial policies by the world’s largest economies highlights the importance of resilient low-carbon supply chains as a key policy objective. China has a long-standing national planning strategy, based on Five-Year Plans, while the U.S. has turned to explicit, climate-oriented industrial policy through the Inflation Reduction Act. In contrast to the U.S. and China, the EU’s approach to industrial policy – with the “Fit for 55” climate transition plan, REPowerEU, and EU Green Deal Industrial Plan and Net Zero Industry Act – emphasizes the principle of free trade and the need to abide by WTO rules, maintain competitive markets, and deepen the EU’s internal market. These industrial policies interact with geoeconomic fragmentation, and could either amplify or mitigate it. In parallel to these decarbonization trends, investment in unabated fossil generation remains high, on a par with its 2016 level (IEA, 2023; IMF, forthcoming a), with significant volatility in prices. If and when the transition gains momentum, a large amount of assets – notably fossil assets – could become stranded if investment exceeds perceived future needs (Pfeiffer et al., 2018; Mercure et al., 2018a, 2021; Semieniuk et al., 2022, van der Ploeg and Rezai, 2020).6 However, price spikes could occur in the opposite scenario if stranded assets are excessively anticipated and investment collapses prematurely. Hence, this points to a case for international coordination and regulation policies within climate policy frameworks (CFMCA, 2023; Krogstrup and Oman, 2019). Supply-demand imbalances could lead to significant volatility in oil and gas markets, in part generated by instability in market regimes motivated by geopolitics (Van der Graaf and Bradshaw, 2018), affecting a wide range of activities and assets, from manufacturing to services. In 2022, short term supply shocks such as the Russian reduction of gas exports to Europe and the G7 sanctions hitting Russian oil exports were complemented by a shift in oil producer strategy to maximize shareholder value rather than production and speculation (Weber and Wasner, 2023; Breman and Storm, 2023). Such volatility can be expected to persist as the market declines and investment and demand coordination becomes harder. However, until the oil market is firmly in decline, stranded assets are likely to be invested in as the high profits in a shortage period induce oil companies to expand investment in order to partake in the short-term profit boom. But since the resulting assets are long-lived, they are vulnerable to subsequent stranding. The European 5 Broadly speaking, stranded assets can be defined as investments that stop returning a profit before the end of their life cycle. 6 Current expectations, as shown by the limited pricing of climate risk in the banking sector (Beyene et al., 2021), are clearly not aligned with the Paris Agreement, particularly in the banking sector. IMF WORKING PAPERS Cross-Border Risks of a Global Economy in Mid-Transition INTERNATIONAL MONETARY FUND 7 oil majors’ recent adjustment of their transition plans, and OPEC's upward revision of its 2045 global oil demand projection upward from 100.6 to 110 million barrel per day in an interval of only 9 months (OPEC, 2022; Reuters, 2023), suggest this dynamic is at play. Furthermore, the value of fossil exports and imports may not necessarily be replaced by trade in other commodities, which could determine the stance of countries on climate action. In particular, the prospect of declining demand for oil and gas and resulting disproportionate macroeconomic impacts on producing countries could drive geopolitical conflict or political maneuvers aiming to capture larger shares of declining markets at the expense of other producers. Electricity is not an easily traded commodity since long-distance transport requires expensive interconnectors and transmission lines (which can be exposed to weather and climate extreme events), whereas most countries have substantial renewable energy potential over their territory that enable local electricity production (Mercure and Salas, 2012). International trade in green hydrogen is emerging but will unlikely match today’s volumes of trade in fossil, given that it is not used in as many applications nor with volumes of the same size (IRENA, 2022). Moreover, net exporters of fossil and hydrogen and other renewable electricity-based energy carriers need not be the same (Berrada and Laasmi, 2021; Hank et al., 2020). Perhaps more importantly than trade in renewable energy itself, the world economy is projected to experience growth in trade in low-carbon technology/capital goods and critical minerals (Boer et al., 2021), as well as the intermediate goods and industrial equipment required to produce or refine them.

#### Decline causes nuclear war by initiating escalation throughout global hotspots.

Ellissa Cavaciuti-Wishart et al. 24, MPhil, Head, Global Risks, World Economic Forum; Sophie Heading, MA, Lead, Global Risks, World Economic Forum; Kevin Kohler, MA, Specialist, Global Risks, World Economic Forum; Saadia Zahidi, MPhil, Managing Director, World Economic Forum, "Global Risks 2024: At a Turning Point," & "Global Risks 2034: Over the Limit," in The Global Risks Report 2024, Chapter 1 & 2, January 2024, pg. 14-39. //JDi [italics in original]

Weakened systems only require the smallest shock to edge past the tipping point of resilience. In the second time frame covered by the survey, respondents were asked to rank the likely impact of risks in the next two years. The results suggest that corrosive socioeconomic vulnerabilities will be amplified in the near term, with looming concerns about an Economic downturn (Chapter 1.5), resurgent risks such as Interstate armed conflict (Chapter 1.4), and rapidly evolving risks like Misinformation and disinformation (Chapter 1.3). As discussed in last year’s Global Risks Report, less predictable and harder-to-handle inflation heightens the risk of miscalibration of efforts to balance price stability and economic growth (Chapter 1.5: Economic uncertainty). Economic risks are notable new entrants to the top 10 rankings this year, with both Inflation (#7) and Economic downturn (#9) featuring in the two-year time frame (Figure 1.3). Economic risks are prioritized in particular by public- and private-sector respondents (Figure 1.5). Geoeconomic confrontation (#14) is a marked absence from the top 10 rankings this year (Figure 1.4) and has decreased in perceived severity compared to last year’s scores. However, like related economic risks, it features among the top concerns for both public- and private-sector respondents (at #10 and #11, respectively) as a continuing source of economic volatility. [Figures omitted] Misinformation and disinformation has risen rapidly in rankings to first place for the two-year time frame, and the risk is likely to become more acute as elections in several economies take place this year (Chapter 1.3: False information). Societal polarization is the third-most severe risk over the short term, and a consistent concern across nearly all stakeholder groupings (Figures 1.5 and 1.6). Divisive factors such as political polarization and economic hardship are diminishing trust and a sense of shared values. The erosion of social cohesion is leaving ample room for new and evolving risks to propagate in turn. Societal polarization, alongside Economic downturn, is seen as one of the most central risks in the interconnected “risks network”, with the greatest potential to trigger and be influenced by other risks (Figure 1.7). [Figures omitted] Interstate armed conflict (#5) rises in the rankings for the two-year horizon, across nearly all stakeholder groups, except for government respondents. This divergence may simply reflect different views around defining conflict: interstate armed conflict in the strict definition has remained relatively rare thus far, but international interventions in intrastate conflict are on the rise (Chapter 1.4: Rise in conflict). Extreme weather events, a persistent concern between last year and this year, is at #2, Cyber insecurity at #4, Involuntary migration at #8 and Pollution at #10, rounding out the top 10 concerns in respondents’ risk perceptions through to 2026. Overall, global risks have lower severity scores compared to last year’s results.7 Further down in the two-year time frame rankings, Critical change to Earth systems comes in at #11, Debt in 16th place, and Adverse outcomes of AI technologies and other frontier technologies in 29th and last place, respectively. The following sections explore some of the most severe risks that many expect to play out over the next two years, focusing on three entrants to the top 10 risks list over the short term: Misinformation and disinformation (#1), Interstate armed conflict (#5) and Economic downturn (#9). We briefly describe the latest developments and key drivers for false information, a rise in conflict and economic uncertainty, and consider their emerging implications and knock-on effects. False information [Figure omitted] Misinformation and disinformation may radically disrupt electoral processes in several economies over the next two years. A growing distrust of information, as well as media and governments as sources, will deepen polarized views – a vicious cycle that could trigger civil unrest and possibly confrontation. There is a risk of repression and erosion of rights as authorities seek to crack down on the proliferation of false information – as well as risks arising from inaction. The disruptive capabilities of manipulated information are rapidly accelerating, as open access to increasingly sophisticated technologies proliferates and trust in information and institutions deteriorates. In the next two years, a wide set of actors will capitalize on the boom in synthetic content,8 amplifying societal divisions, ideological violence and political repression – ramifications that will persist far beyond the short term. Misinformation and disinformation (#1) is a new leader of the top 10 rankings this year. No longer requiring a niche skill set, easy-to-use interfaces to large-scale artificial intelligence (AI) models have already enabled an explosion in falsified information and so-called ‘synthetic’ content, from sophisticated voice cloning to counterfeit websites. To combat growing risks, governments are beginning to roll out new and evolving regulations to target both hosts and creators of online disinformation and illegal content.9 Nascent regulation of generative AI will likely complement these efforts. For example, requirements in China to watermark AI-generated content may help identify false information, including unintentional misinformation through AI hallucinated content.10 Generally however, the speed and effectiveness of regulation is unlikely to match the pace of development. Synthetic content will manipulate individuals, damage economies and fracture societies in numerous ways over the next two years. Falsified information could be deployed in pursuit of diverse goals, from climate activism to conflict escalation. New classes of crimes will also proliferate, such as non-consensual deepfake pornography or stock market manipulation.11 However, even as the insidious spread of misinformation and disinformation threatens the cohesion of societies, there is a risk that some governments will act too slowly, facing a trade-off between preventing misinformation and protecting free speech, while repressive governments could use enhanced regulatory control to erode human rights. Mistrust in elections Over the next two years, close to three billion people will head to the electoral polls across several economies, including the United States, India, the United Kingdom, Mexico and Indonesia (Figure 1.9).12 The presence of misinformation and disinformation in these electoral processes could seriously destabilize the real and perceived legitimacy of newly elected governments, risking political unrest, violence and terrorism, and a longer-term erosion of democratic processes. Recent technological advances have enhanced the volume, reach and efficacy of falsified information, with flows more difficult to track, attribute and control. The capacity of social media companies to ensure platform integrity will likely be overwhelmed in the face of multiple overlapping campaigns.13 Disinformation will also be increasingly personalized to its recipients and targeted to specific groups, such as minority communities, as well as disseminated through more opaque messaging platforms such as WhatsApp or WeChat.14 The identification of AI-generated mis- and disinformation in these campaigns will not be clear-cut. The difference between AI- and humangenerated content is becoming more difficult to discern, not only for digitally literate individuals, but also for detection mechanisms.15 Research and development continues at pace, but this area of innovation is radically underfunded in comparison to the underlying technology.16 Moreover, even if synthetic content is labelled as such,17 these labels are often digital and not visible to consumers of content or appear as warnings that still allow the information to spread. Such information can thus still be emotively powerful, blurring the line between malign and benign use. For example, an AI-generated campaign video could influence voters and fuel protests, or in more extreme scenarios, lead to violence or radicalization, even if it carries a warning by the platform on which it is shared that it is fabricated content.18 The implications of these manipulative campaigns could be profound, threatening democratic processes. If the legitimacy of elections is questioned, civil confrontation is possible – and could even expand to internal conflicts and terrorism, and state collapse in more extreme cases. Depending on the systemic importance of an economy, there is also a risk to global trade and financial markets. State-backed campaigns could deteriorate interstate relations, by way of strengthened sanctions regimes, cyber offense operations with related spillover risks, and detention of individuals (including targeting primarily based on nationality, ethnicity and religion).19 [Figure omitted] Societies divided Misinformation and disinformation and Societal polarization are seen by GRPS respondents to be the most strongly connected risks in the network, with the largest potential to amplify each other. Indeed, polarized societies are more likely to trust information (true or false) that confirms their beliefs. Given distrust in the government and media as sources of false information,20 manipulated content may not be needed – merely raising a question as to whether it has been fabricated may be sufficient to achieve relevant objectives. This then sows the seeds for further polarization. As identified in last year’s *Global Risks Report* (*Chapter 1.2: Societal polarization*), the consequences could be vast. Societies may become polarized not only in their political affiliations, but also in their perceptions of reality, posing a serious challenge to social cohesion and even mental health. When emotions and ideologies overshadow facts, manipulative narratives can infiltrate the public discourse on issues ranging from public health to social justice and education to the environment. Falsified information can also fuel animosity, from bias and discrimination in the workplace to violent protests, hate crimes and terrorism. Some governments and platforms, aiming to protect free speech and civil liberties, may fail to act to effectively curb falsified information and harmful content, making the definition of “truth” increasingly contentious across societies. State and non-state actors alike may leverage false information to widen fractures in societal views, erode public confidence in political institutions, and threaten national cohesion and coherence. Trust in specific leaders will confer trust in information, and the authority of these actors – from conspiracy theorists, including politicians, and extremist groups to influencers and business leaders – could be amplified as they become arbiters of truth. Defining truth False information could not only be used as a source of societal disruption, but also of control, by domestic actors in pursuit of political agendas.21 Although misinformation and disinformation have long histories, the erosion of political checks and balances, and growth in tools that spread and control information, could amplify the efficacy of domestic disinformation over the next two years.22 Global internet freedom is already in decline and access to wider sets of information has dropped in numerous countries.23 Falls in press freedoms in recent years and a related lack of strong investigative media, are also significant vulnerabilities that are set to grow.24 Indeed, the proliferation of misinformation and disinformation may be leveraged to strengthen digital authoritarianism and the use of technology to control citizens. Governments themselves will be increasingly in a position to determine what is true, potentially allowing political parties to monopolize the public discourse and suppress dissenting voices, including journalists and opponents.25 Individuals have already been imprisoned in Belarus and Nicaragua, and killed in Myanmar and Iran, for online speech.26 [Figure omitted] The export of authoritarian digital norms to a wider set of countries could create a vicious cycle: the risk of misinformation quickly descends into the widespread control of information which, in turn, leaves citizens vulnerable to political repression and domestic disinformation.27 GRPS respondents highlight strong bilateral relationships between Misinformation and disinformation, Censorship and surveillance (#21) and the Erosion of human rights (#15), indicating a higher perceived likelihood of all three risks occurring together (Figure 1.10). This is a particular concern in those countries facing upcoming elections, where a crackdown on real or perceived foreign interference could be used to consolidate existing control, particularly in flawed democracies or hybrid regimes. Yet more mature democracies could also be at risk, both from extensive exercises of government control or due to trade-offs between managing mis- and disinformation and protecting free speech. In January last year, Twitter and YouTube agreed to remove links to a BBC documentary in India.28 In Mexico, civil society has been concerned about the government's approach to fake news and its implications for press freedom and safety.29 Rise in conflict [Figure omitted] Escalation in three key hotspots – Ukraine, Israel and Taiwan – is possible, with high-stakes ramifications for the geopolitical order, global economy, and safety and security. Geographic, ideological, socioeconomic and environmental trends could converge to spark new and resurgent hostilities, amplifying state fragility. As the world becomes more multipolar, a widening array of pivotal powers will step into the vacuum, potentially eroding guardrails to conflict containment. The world has become significantly less peaceful over the past decade, with conflict erupting in multiple regions last year.30 Active conflicts are at the highest levels in decades, while related deaths have witnessed a steep increase, nearly quadrupling over the two-year period from 2020 to 2022 (Figure 1.12), largely attributable to developments in Ethiopia and Ukraine. While difficult to attribute to a single cause, longer-term shifts in geopolitical power, economic fragility and limits to the efficacy and capacity of international security mechanisms have all contributed to this surge. Interstate armed conflict (#5) is a new entrant to the top 10 risk rankings this year. Specific flashpoints could absorb focus and split the resources of major powers over the next two years, degrading global security and destabilizing the global financial system and supply chains. Although war between two states in the strict definition remains relatively rare (Figure 1.12), this could contribute to conflict contagion, leading to rapidly expanding humanitarian crises that overwhelm the capacity to respond. [Figure omitted] High-stakes hotspots Over the next two years, the attention and resources of global powers are likely to be focused on three hotspots in particular: the war in Ukraine, the Israel-Gaza conflict and tensions over Taiwan. Escalation in any one of these hotspots would radically disrupt global supply chains, financial markets, security dynamics and political stability, viscerally threatening the sense of security and safety of individuals worldwide. All three areas stand at a geopolitical crossroads, where major powers have vested interests: oil and trade routes in the Middle East, stability and the balance of power in Eastern Europe, and advanced technological supply chains in East Asia. Each could lead to broader regional destabilization, directly drawing in major power(s) and escalating the scale of conflict. All three also directly involve power(s) reckoned to possess nuclear capabilities. Over the next two years, the war in Ukraine could sporadically alternate between intensifying and refreezing. Despite sanctions, Russia has continued to benefit from energy profits and commodity exports – and this could increase further if the conflict in the Middle East widens.31 Pro-Russian or neutral sentiment in Eastern and Central Europe could soften support from Ukraine’s European allies,32 while support in the United States could wane under domestic pressures, other international priorities, or under a new government. Global divisions with respect to the Middle East conflict may also complicate efforts by Ukraine to maintain unity with Western allies, while also garnering support from the Global South.33 If the conflict intensifies, it is still more likely to do so through conventional rather than nuclear means, but it could also expand to neighbouring countries. While post-conflict scenarios for both Ukraine and Russia are difficult to predict, the war could ‘refreeze’ into a prolonged, sporadic conflict that could last years or even decades.34 Proximate developments in the Middle East are a source of considerable uncertainty, risking further indirect or direct confrontation between global powers. If the Israel-Gaza conflict destabilizes into wider regional warfare, more extensive intervention by major powers is possible, including Iran and the West.35 Beyond potentially seismic shocks to global energy prices and supply chains, escalation could split the attention and resources of the EU and the United States between Ukraine and Israel.36 The scale of Gulf countries’ or Western intervention is uncertain; it’s likely to continue to be deeply polarizing domestically and hold significant political sway. Numerous GRPS respondents also cited Taiwan and disputed territories in East and South-East Asia as areas of concern. In contrast to Russia, which doubled its defense spending target to more than $100 billion in 2023, and the United States, which allocated over $113 billion in assistance relating to the war in Ukraine alone,37 China has largely acted as a non-interventionist power in both the Ukraine and Middle East conflicts, avoiding the risk of overstretch.38 While there is no evidence to suggest that escalation is imminent, there remains a material possibility of accidental or intentional outbreak of hostilities, given heightened activity in the region.39 Conflict contagion As high-stakes hotspots undermine global security, a wider set of trends may fuel a combustible environment in which new and existing hostilities are more likely to ignite. As conflicts spread, guardrails to their containment are eroding and resolve for long-term solutions have stalled.40 In parallel, the internationalization of conflicts by a wider set of alternate powers will accelerate ‘multipolarity’ and the risk of inadvertent escalation. First, simmering tensions and frozen conflicts that are proximate to existing hotspots could heat up. For example, spillover impacts from a high concentration of conflicts, such as in Asia and Africa (Figure 1.13), could range from more readily available arms trafficking to conflict-driven migration. Other states could also deliberately stoke tensions in neighbouring countries to divert attention and resources, through disinformation campaigns or the deployment of state-backed militia groups, for example. Frozen conflicts at risk could include the Balkans, Libya, Syria, Kashmir, Guyana, the Kurdish region and Korean peninsula.41 These risks are well-recognized by business leaders: Interstate armed conflict features as a top-five risk in 20 countries (18%) surveyed in the Forum’s Executive Opinion Survey (EOS, see Appendix C: Executive Opinion Survey: National Risk Perceptions), including Egypt, Iraq, Kazakhstan and Serbia, and is the top risk in Armenia, Georgia, Kyrgyzstan and Japan. Second, resource stress, economic hardship and weakened state capacity will likely grow and, in turn, fuel conflict.42 There may also be a rise of ‘ungoverned countries’, where non-state actors fight for control over large swathes of territory, or where parties not recognized by the international system gain full control. For example, resource-rich countries could become caught in a battleground of proxy warfare between multiple powers, including neighbouring economies, organized crime networks and paramilitary groups (Chapter 2.6: Crime wave).43 [Figure omitted] Third, with instant information networks and reinforcing algorithms, the symbolism of high-stakes hotspots could trigger contagion beyond conflict geographies. Deeply ingrained ideological grievances are in some cases driving hostilities, and these divisions are resonating with communities and political parties elsewhere. This expands beyond religious and ethnic divisions to broader challenges to systems of governance. National identities, international law and democratic values are coming into question, contributing to civil unrest, threatening human rights, and reigniting violence, including in advanced democracies and between the Global North and South. North-South rift Dissatisfaction with the continued political, military and economic dominance of the Global North is growing, particularly as states in the Global South bear the brunt of a changing climate, the aftereffects of pandemic-era crises and geoeconomic rifts between major powers. Historical grievances of colonialism, combined with more recent ones regarding the costs of food and fuel, geopolitical alliances, the United Nations and Bretton Woods systems, and the loss and damage agenda, could accelerate anti-Western sentiment over the next two years. In conjunction with more thinly spread resources and tighter economic conditions, military power projection by the West could fade further, potentially creating power vacuums in parts of Africa, the Middle East and Asia. France, for example, has withdrawn troops on request from Mali, Burkina Faso and Niger over the past two years.44

#### Extinction!

Starr 22, Steven. Director of the University of Missouri’s Clinical Laboratory Science Program, as well as a senior scientist at the Physicians for Social Responsibility. He has worked with the Swiss, Chilean, and Swedish governments in support of their efforts at the United Nations to eliminate thousands of high-alert, launch-ready U.S. and Russian nuclear weapons; he maintains the website Nuclear Darkness. “Fred Reed Indicates What Nuclear War Would Be Like, but Steven Starr’s Comment Better Describes the Death of the Planet,” Oct 24, 2022, https://www.paulcraigroberts.org/2022/10/24/fred-reed-indicates-what-nuclear-war-would-be-like-but-steven-starrs-comment-better-describes-the-death-of-the-planet/

Russia has about 700 strategic nuclear warheads that each have an explosive power of 800,000 tons of TNT. These are among the “launch-ready” weapons they can launch in a few minutes time. Each of these warheads, on an average weather day, will ignite fires over an area of 150 square miles. In a matter of 10-15 minutes, these fires will coalesce into a single gigantic nuclear firestorm, with air temperatures of 500 -600 degrees Fahrenheit and hurricane force winds blowing towards the center of the fire zone. No one in the fire zone will survive the fire. For details, see an article that I co-authored in the Bulletin of the Atomic Scientists, “What would happen if an 800-kiloton nuclear warhead detonated above midtown Manhattan?”. https://thebulletin.org/2015/02/what-would-happen-if-an-800-kiloton-nuclear-warhead-detonated-above-midtown-manhattan/ A war fought with hundreds or thousands of U.S. and Russian strategic nuclear weapons would ignite immense nuclear firestorms covering land surface areas of many thousands or tens of thousands of square miles. **Peer-reviewed studies have calculated** that up to 180 million tons of **smoke and soot** would be **created by** these **nuclear firestorms**. See the https://nuclearfamine.org/ and http://climate.envsci.rutgers.edu/robock/robock\_nwpapers.html for details. Most of the smoke from these firestorms would rapidly rise above cloud level into the stratosphere, where it would rapidly spread around the earth. In a matter of a few weeks, a global stratospheric smoke layer would form, which **would block** up to 70% of warming **sunlight** from reaching earth’s surface in the Northern Hemisphere and 35% in the Southern Hemisphere. The smoke, being above cloud level, could not be rained out and it would remain in the stratosphere for a decade or longer. The loss of warming sunlight would cause daily temperatures to fall below freezing every day for up to 3 years in central North American and central Eurasia. The intense cold weather would endure for many years, **preventing crops from being grown**. Most **humans and animal populations would perish from starvation**. Unfortunately, those in charge of the US military have rejected the findings of the scientific studies on nuclear winter. I wrote about this for the Federation of American Scientists, see “Turning a Blind Eye Towards Armageddon — U.S. Leaders Reject Nuclear Winter Studies” at https://fas.org/2017/01/turning-a-blind-eye-towards-armageddon-u-s-leaders-reject-nuclear-winter-studies/ In 2010, at the UN meetings of the First Committee, I asked Rose Gottemoeller and Anatoly Atonov (during their briefing on New START) if they were familiar with the new studies on nuclear winter, which predict that a US-Russian nuclear war would wipe out most of humanity. Both answered “no”. Perhaps they have learned more about nuclear winter since 2010. But it is willful blindness to chose to ignore such information and criminal insanity to start a **nuclear war** that **would amount to** a mass **extinction** event.

#### And, it locks in carbon emissions.

Don Grant et. al, 8-29-2024, "A worldwide analysis of stranded fossil fuel assets’ impact on power plants’ CO2 emissions", Nature, <https://www.nature.com/articles/s41467-024-52036-8> [Grant: Department of Sociology, University of Colorado Boulder, Boulder, CO, USA Renewable and Sustainable Energy Institute, University of Colorado Boulder, Boulder, CO, USA. Hansen: Department of Environmental Studies, Dartmouth College, Hanover, NH, USA. Jorgenson: Department of Sociology, University of British Columbia, Vancouver, BC, Canada Department of Theoretical Economics, Vilnius University, Vilnius, Lithuania. Longhofer: Goizueta Business School, Emory University, Atlanta, GA, USA] DOA: 4/1/2025 //RRM

* Green Paradox: policies meant to reduce emissions cause spikes in emissions
* Stranded assets: assets that cannot produce revenue before the end of their lifetime

The baseline model (model 1) reveals that plants release more carbon when they emitted at high levels in 2009, use coal or gas as their primary fuels, have more electrical capacity, use a higher percentage of their capacity, and have capacity utilization rates that have increased over time. Plants also emit more carbon in countries that are highly dependent on the fossil fuel industry to generate power. After accounting for the effects of these and other controls, the baseline model shows that in countries with more potentially stranded fossil fuel assets, plants have significantly higher emission levels compared to plants whose countries have fewer assets at risk. Specifically, a 1% change (measured in millions of euros) of potentially stranded assets results in a .050% change in emissions, holding constant all other variables in the model. This finding is consistent with our first prediction that stranded assets increase plants’ emissions by fostering a more lenient regulatory climate.

In models 2 through 5, we examine whether changes in coal, oil, and gas prices influence plants’ emissions and can explain the effect of stranded assets observed in model 1. Findings indicate that none of the price variables has a significant effect on emissions regardless of whether they are added individually (models 2, 3, and 4) or as a group (model 5) to the equation. Their inclusion, therefore, has a negligible effect on the stranded assets effect across all four specifications. These results contradict the conventional green paradox thesis that fossil fuel suppliers will induce more emissions in the short run by lowering the price of coal, oil, and gas inputs. Instead, they comport with Di Maria et al.’s argument that plants’ long-term future contracts with fossil fuel suppliers often prevent them from responding to spot market changes in coal, oil, and gas.

To determine whether contractually constrained plants might still burn fossil fuels faster in countries where more carbon reserves are financially at risk, we interact our measures of stranded assets and change in plant capacity utilization rate in model 6. Results indicate there is a statistically significant interaction between these two factors. This is in keeping with our second prediction that when located in countries with more at-risk assets, plants have a stronger incentive to speed up the processing of the fuels they have already purchased and thus increase their CO2 emissions in the short term. Figure 2 shows the predicted effect of changes in plants’ utilization rate on their CO2 emission levels at a mean level of (logged) stranded assets (9.1), at 1 standard deviation below the mean (5.5), and at 1 standard deviation above the mean (12.8). Here we see that where more fossil fuel reserves are in jeopardy, plants utilize a larger percentage of their capacity over time, causing their emissions to rise. (Supplementary Table 1, which shows the determinants of plants’ CO2 emission levels under a 2 °C climate stabilization scenario that would regularly expose close to three times as many people to extreme heat, reports results nearly identical to those shown in Table 1).

Fig. 2: How the predicted effect of change in plant capacity utilization rate on power plants’ CO2 emission levels varies depending on total stranded assets.

figure 2

Reports the predicted effect of changes in plants’ capacity utilization rate on their (logged) CO2 emission levels at a mean level of (logged) stranded assets (9.1), at 1 standard deviation below the mean (5.5), and at 1 standard deviation above the mean (12.8).

Full size image

In Table 3, we assess the robustness of the association between our dependent and key independent variables. Models 1 and 2 are estimated for only plants that officially report their emissions, and the latter model includes the interaction between stranded assets and change in plant capacity utilization rate. In Model 3, we operationalize total stranded assets using an inverse hyperbolic sine function. The results of these three models are nearly identical to those reported in models 5 and 6 in Table 2. In models 4, 5, and 6, we examine whether plants emit more carbon because particular types of fossil fuels are at risk. Findings reveal that unburnable coal, gas, and oil are each significantly related to plants’ CO2 emission levels, providing further proof that the effects of our key independent variable – total stranded assets – are robust.

Table 3 Robustness checks of the association between the dependent and key independent variables

Full size table

Relative magnitude of the stranded assets effect

Having determined that stranded assets have a statistically significant effect on plants’ CO2 emission levels, we now consider the relative magnitude of that effect. In Table 4, we compare the total annual tonnes of carbon released by (the world’s or a nation’s) plants solely in response to at-risk assets to the remaining annual carbon budgets31 of the world’s and individual nations’ electricity sectors (see Methods). The first two columns of Table 4 reveal that for the world as a whole, the increase in annual CO2 emissions triggered by potentially stranded assets is 12.08 million metric tonnes per year or 0.21% of the electricity sector’s annual carbon budget when the chance of limiting global warming to 1.5 °C above pre-industrial levels is set to 50%. The third column shows that when the world’s annual budget is constrained further to have a 66% chance of staying below 1.5 °C, the relative magnitude of plants’ emissions is 0.28%.

Table 4 Magnitude of extra annual electricity-based CO2 emissions associated with stranded assets under a 1.5 °C scenario

Full size table

The first three columns of Table 4 also report the same estimates for the five countries with the most absolute CO2 emissions. Here we see, for instance, that the additional annual emissions associated with at-risk assets in China (3.09 million metric tonnes) are 0.19% to 0.26% of the budget for this country’s electricity sector. The extra emissions triggered by at-risk assets amount to even smaller percentages for India (0.02% to 0.04%) and Japan (0.0010% to 0.0013%). The relative magnitudes of plants’ extra emissions in the United States and Russia are higher, ranging, respectively, from 1.12% to 1.61% and .84% to 1.19%.

Although these findings might suggest that the percentage of carbon budgets used up by plants due to potentially stranded assets is modest, when one adds up these percentages over time, a more concerning picture emerges. As the last column reveals, during a period when the carbon budget will almost surely be breached and, therefore, every fractional “expenditure” of that budget matters32, the extra emissions associated with stranded assets could amount to between 2.1% to 2.8% of the world’s carbon allowance over a ten-year period. In the United States and Russia, the situation is even more troubling. These countries could exhaust 11.2% to 16.1% and 8.4% to 12%, respectively, of their electricity sectors’ carbon budgets due just to the stranded assets effect. This suggests that the financial pressures to “use it or lose it” are especially great among these two key incumbents of the carbon regime. In fact, the United States and Russia stand to lose the most profits from the physical stranding of assets12 and their power plants are older, on average, (30.3 and 30.6 years, respectively) than those in other countries (25.5 years).

Discussion

Past research on the green paradox has emphasized reactions on the supply side, whereby fossil fuel companies accelerate the extraction of carbon reserves, leading to a reduction in current fossil fuel prices and, in turn, an increase in CO2 emissions. While there is ample evidence that suppliers extract more fossil fuels and sell them at cheaper prices in anticipation of stronger environmental policies, there is less support for the idea that price decreases result in more CO2 emissions, which has cast doubt on the green paradox thesis. In contrast, our study redirects attention to the demand side, positing that regulatory leniency and power plants’ vested interest in their long-term fossil fuel contracts make plants more willing to burn fossil fuels earlier and thus are the mechanisms that produce the green paradox. In keeping with our argument that at-risk fossil fuel assets give government actors a financial incentive to relax environmental standards, results show that plants emit more carbon pollution in countries where vast amounts of fossil fuel reserves would be stranded under the Paris Agreement. And in keeping with our other argument that at-risk reserves motivate contractually constrained plants to speed up the processing and burning of their purchased inputs, findings indicate that stranded assets and plants’ capacity utilization rates positively interact, causing plants to further increase their emissions. While the extra amount of carbon released each year due to the stranded asset effect is moderate, its cumulative impact on the electricity sector’s remaining carbon budget could be significant in certain key countries. In addition to encouraging more theory building on the green paradox, therefore, our study’s findings suggest that if important policy-making communities are to develop effective transition strategies, they, too, must pay greater attention to the demand side of fossil fuel consumption.

An important topic for future research is whether the effect of stranded fossil fuel assets on plants’ emissions is strengthening over time33. The volume of emissions from the effect could dwindle as the fossil fuel sector shrinks. Or it could grow if more fossil fuel reserves are discovered through new production technologies. Additional research is also needed on the mechanisms we have theorized linking the key independent variable to the dependent variable. Although stranded assets’ direct and interactive effects on power plants’ CO2 emissions can be plausibly explained by countries’ regulatory leniency and plants’ vested interest in their long-term fossil fuel contracts, measures of these concepts are needed to determine to what extent they, as variables, mediate the observed effects of stranded assets in a causal chain of relationships34.

#### Extinction.

Dr. Yew-Kwang **Ng 19** [Winsemius Professor of Economics at Nanyang Technological University, Fellow of the Academy of Social Sciences in Australia and Member of Advisory Board at the Global Priorities Institute at Oxford University, PhD in Economics from Sydney University, “Keynote: Global Extinction and Animal Welfare: Two Priorities for Effective Altruism”, Global Policy, Volume 10, Number 2, May 2019, pp. 258–266, https://onlinelibrary.wiley.com/doi/10.1111/1758-5899.12647] Accessed 10/09/2024, DSL

Catastrophic **climate change** Though by no means certain, CCC causing **global extinction** is **possible** due to **interrelated factors** of **non-linearity**, **cascading effects**, **positive feedbacks**, **multiplicative factors**, **critical thresholds** and **tipping points** (e.g. Barnosky and Hadly, 2016; Belaia et al., 2017; Buldyrev et al., 2010; Grainger, 2017; Hansen and Sato, 2012; IPCC 2014; Kareiva and Carranza, 2018; Osmond and Klausmeier, 2017; Rothman, 2017; Schuur et al., 2015; Sims and Finnoff, 2016; Van Aalst, 2006).7 A possibly **imminent** tipping point could be in the form of ‘an **abrupt ice sheet collapse** [that] could cause a **rapid sea level rise’** (Baum et al., 2011, p. 399). There are **many avenues** for **positive feedback** in global warming, including: • the replacement of an **ice sea** by a **liquid ocean surface** from **melting** reduces the **reflection** and increases the **absorption of sunlight**, leading to faster warming; • the **drying of forests** from warming increases **forest fires** and the release of more **carbon**; and • higher **ocean** **temperatures** may lead to the **release of methane** trapped under the ocean floor, producing **runaway** global warming. Though there are also avenues for **negative** feedback, the **scientific consensus** is for an **overall net positive feedback** (Roe and Baker, 2007). Thus, the Global Challenges Foundation (2017, p. 25) concludes, ‘The world is currently **completely unprepared** to envisage, and even less **deal with**, the consequences of **CCC’**. The threat of sea-level rising from global warming is well known, but there are also other likely and more imminent threats to the survivability of mankind and other living things. For example, Sherwood and Huber (2010) emphasize the **adaptability limit** to climate change due to **heat stress** from high environmental wet-bulb temperature. They show that ‘even **modest** global **warming** could ... expose large fractions of the [world] population to **unprecedented heat stress’** p. 9552 and that with substantial global warming, ‘the area of land rendered **uninhabitable by heat stress** would **dwarf** that affected by rising **sea level’** p. 9555, making **extinction much more likely** and the relatively moderate damages estimated by most integrated assessment models unreliably low. While **imminent** extinction is very unlikely and may not come for a long time even under business as usual, the main point is that we **cannot rule it out**. Annan and Hargreaves (2011, pp. 434–435) may be right that there is ‘an upper 95 per cent probability limit for S [temperature increase] ... to lie close to 4°C, and certainly well below 6°C’. However, probabilities of 5 per cent, 0.5 per cent, 0.05 per cent or even 0.005 per cent of excessive warming and the resulting extinction probabilities cannot be ruled out and are unacceptable. Even if there is only a **1 per cent probability** that there is a time **bomb in the** air**plane**, you **probably want to change your flight**. **Extinction of the whole world is more important to avoid by literally a trillion times**.

## 1NC---Prolif

#### Contention two is prolif.

#### Trump’s actions with Ukraine put us on the brink of nuclear prolif – even one country pursuing nukes cascades globally.

Patrick Tucker, 3-9-2025, "Experts fear cascade of nuclear proliferation as Trump shakes alliances", Defense One, <https://www.defenseone.com/threats/2025/03/experts-fear-cascade-nuclear-proliferation-trump-shakes-alliances/403633/> [Patrick Tucker is science and technology editor for Defense One. He’s also the author of The Naked Future: What Happens in a World That Anticipates Your Every Move? (Current, 2014). Previously, Tucker was deputy editor for The Futurist for nine years. Tucker has written about emerging technology in Slate, The Sun, MIT Technology Review, Wilson Quarterly, The American Legion Magazine, BBC News Magazine, Utne Reader, and elsewhere.] DOA: 3/11/2025 \*brackets in original\* //RRM

U.S. allies around the world are warming to the idea of developing their own nuclear weapons, the result of a growing sense that U.S. President Donald Trump may abandon key international security commitments and alliances, former senior defense and White House officials told Defense One. Decades of nonproliferation efforts to persuade countries to forgo nuclear weapons, work led by the United States through security guarantees, are on the verge of collapse, the officials said. Should one or two nations launch nuclear projects, others will quickly follow. That could provoke a military response from Russia or China, which might touch off yet more nuclear development in a self-reinforcing, destabilizing cycle. What’s changed in the last two weeks? “The Trump administration's approach to Ukraine and Russia has significantly undercut allied confidence in the United States, including on extended [nuclear] deterrence,” Eric Brewer, a former director for counterproliferation at the National Security Council. “Not only is [Trump] pivoting away from allies but he's seemingly pivoting toward Russia.” The shift has shaken U.S. allies. France—the only NATO member with a nuclear arsenal that doesn’t depend on U.S. technology—hastened to shore up European deterrence by proposing to extend its nuclear “umbrella” to other countries. "I have decided to open the strategic debate on the protection of our European continental allies through our deterrence,” French President Emmanuel Macron said last week. Leaders from Berlin to the Baltics quickly praised the idea. German Chancellor-in-waiting Friedrich Merz on Sunday said, “We should talk with both countries [France and Britain], always also from the perspective of supplementing the American nuclear shield, which we of course want to see maintained.” But the French proposal leaves many questions unanswered. If France is to convince other nations to huddle under its nuclear umbrella, said one former senior White House senior official who worked on nuclear issues, Paris will need to launch a diplomatic campaign and be willing to share a great deal more information, including classified information, about nuclear decision-making and capabilities—much as the United States did in the 1960s. In the past, similar proposals have led NATO allies to begin talks, but they collapsed over issues such as who would control the weapons, a former senior defense official said. “There's just a lot of questions here about what the French are offering, whether they may really be willing to provide a dual key with Germany for weapons if they put them on German territory for instance. I suspect not,” they said. Indeed, soon after his initial announcement, Macron clarified that France would not share its warheads with other countries. Uncertainty France’s nuclear arsenal of about 290 warheads is larger than Britain’s (under 225) but far smaller than Russia’s (nearly 6,000). Neither has Russia’s diversity of warhead sizes and delivery systems. The U.K.'s small and expensive nuclear submarine fleet is undergoing modernization. France has air-launched cruise missiles. Russia has land-based mobile launchers, siloed ICBMs, bombers, and submarines. There’s a reason Europe made no attempt to keep up with Russia’s weapons development. Western Europe has always relied on the vast U.S. arsenal to deter Russia. But, the former senior defense official explained, France had a different deterrence strategy: hold just one or two major targets, like Moscow or St. Petersburg, in jeopardy. The U.S. idea “was that we were going to develop counter-force capability”—that is, weapons to disable or destroy an enemy’s nuclear capability—“try and take out Soviet weapon systems, command and control, leadership; and try and not go after cities if we could avoid it. The French have never had that kind of compunction. The basis of their strategy was ‘tear an arm off the bear.’ They never thought they could really take on the entire Soviet nuclear force.” In other words, Paris and London can’t destroy Russia’s ability to wage nuclear war—even enough of it to prevent the obliteration of both countries and more of Europe as well. That isn’t particularly reassuring to European leaders who believe that their countries would be a secondary priority for France should Russia attack. That may be why Poland’s Prime Minister ​​Donald Tusk said Friday that his country must “reach for opportunities related to nuclear weapons”—perhaps hinting at launching its own development effort. Proliferation triggers But the real trigger for a new arms race may sit outside of Europe, the officials warned. All of the former officials we spoke to said that South Korea is the U.S. ally that is furthest along in pursuing a new nuclear weapons program. The country feels “the most pressure right now,” said the former senior White House official. That’s true across South Korea’s political elites, including “the opposition party that may win the next election.” Should Seoul start hunting for the fuel to build such a device, Tokyo would likely launch a program of its own, they said, since Japan and South Korea are not treaty allies but do have hundreds of years of conflict history. “I find it hard to believe you'd see a Japan-and-South Korea joint nuclear weapons development project,” said the former senior defense official. All the officials we spoke to agreed that if one nation starts a nuclear-weapon program, others will likely do so as well. “Proliferation will beget more proliferation,” said the former senior White House official. Trump’s recent talk of abandoning treaty allies is not the only change that may push other nations toward nuclearization. He has also hinted that he might withdraw U.S. troops from certain countries, such as Japan or European nations. This would remove a “tripwire” that helps deter foreign attack, the former senior defense official said, and would cause a host government to consider new ways to deter attack on its own.

#### Affirming would invest in the HALEU program – it underpins all nuclear energy tech.

Nuclear Engineering International, 2-27-2025, "Will nuclear rise under Trump?", Nuclear Engineering International, <https://www.neimagazine.com/analysis/will-nuclear-rise-under-trump/> [Published continuously since 1956, Nuclear Engineering International provides technical insight behind the news headlines for all aspects of civil nuclear power generation and its related supply chains. News, analysis and in-depth articles cover topics from frontend fuel cycle to power plant operations and decommissioning. In addition to technical subjects, we also examine market developments, economics, government policy and management issues. Nuclear Engineering International is a media partner for key conferences and exhibitions, allowing the opportunity for brand partnerships.] DOA: 3/11/2025 //RRM

ONE achievements during Trump’s term also included establishing the National Reactor Innovation Center, which provides a platform for private sector technology developers to assess the performance of their reactor concepts through testing and demonstration. The centre continues to be funded, receiving $20m in 2023 (which also saw $120m for Risk Reduction for Future Demonstrations, and $60m for the ARDP Demonstration Reactor). In 2017 the Trump administration also brought the Transient Reactor Test Facility (TREAT) at INL back online, after more than two decades in standby mode. TREAT allows scientists to examine fuel performance under simulated accident conditions. In 2017 the Trump administration brought the Transient Reactor Test Facility (TREAT) back on line at INL (Source: DOE) Trump’s first term saw ONE begin “looking into multiple options to provide small amounts of high assay low-enriched uranium (HALEU) for testing and demonstration of these technologies”. HALEU is not currently commercially available from US suppliers and the DOE is pursuing several pathways to secure a domestic supply, and the Energy Act of 2020 established the HALEU Availability Program to ensure access to HALEU and spur demand for private investment in HALEU production. That programme continued to be funded by the Biden-Harris Administration’s Investing in America agenda, which noted that gaps in supply could delay the deployment of advanced reactors in a timeframe that supports the nation’s net-zero emissions targets by 2050. Recently the DOE promised up to $16m through a new HALEU Transportation Package Funding Opportunity to “research, develop, and acquire Nuclear Regulatory Commission (NRC) licensing for HALEU transportation packages”. It said many advanced reactor designs require HALEU to achieve smaller designs, longer operating cycles, and increased efficiencies over current technologies, but there are limited licensed options to transport HALEU. Programmes like the development and siting of new types of small reactor that are US-designed and built would seem to sit happily in the new administration’s stated plans to boost domestic energy supplies (and potentially export SMRs to overseas customers). Initiatives like the HALEU Availability Program, to ensure the US can supply its own fuel, also seem to be on-message for Trump. Domestically, it suggests the US nuclear industry could see its star rise under the new administration, even as other low-carbon technologies such as offshore wind lose political support. Indeed, while nuclear progress and support probably has to take a different route than the provisions covering low-carbon generation introduced under the Biden administration, such as the Inflation Reduction Act (IRA), domestic nuclear is expected to receive continued support under thew new Trump presidency. The industry could also have support from the new administration on the international stage. The ONE named as its final achievement during Trump’s first term that it saw DOE launch the NICE Future initiative in 2018. This global effort led by the USA, Canada, and Japan aimed to “ensure nuclear energy receives appropriate representation in high-level discussions about clean energy”. The industry will hope to retain that backing in the coming years.

#### Investment erodes non-proliferation safeguards and other deterrents.

John Carlson, 9-12-2024, "HALEU: Potential Safeguards and Non-Proliferation Implications", Vienna Center for Disarmament and Non‑Proliferation, <https://vcdnp.org/haleu-potential-safeguards-and-non-proliferation-implications/> [Background John Carlson joined the VCDNP as a Non-Resident Senior Fellow in July 2019. He holds a number of other appointments, including: Member and Senior Associate Fellow with the Asia-Pacific Leadership Network on Nuclear Non-Proliferation and Disarmament, Member of the International Advisory Council of the International Luxembourg Forum, and Member of the International Verification Consultants Network at VERTIC. Mr. Carlson worked in the Australian Public Service from 1963 to 2010, principally on energy, nuclear and international relations issues, including 21 years as Director General of the Australian Safeguards and Non-Proliferation Office (1989-2010). Concurrent appointments included: Chairman of the IAEA Standing Advisory Group on Safeguards Implementation (SAGSI) from 2001 to 2006, Alternate Governor for Australia at the IAEA Board of Governors, Australian Sherpa to the Nuclear Security Summit in 2010, and founding Chair of the Asia-Pacific Safeguards Network. Mr. Carlson is a Fellow of the Institute of Nuclear Materials Management (INMM) and holds the national award of Member of the Order of Australia (AM). Education Mr. Carlson studied law at the University of Sydney and has post-graduate qualifications in jurisprudence and modern logic.] DOA: 3/11/2025 //RRM

* Nuclear latency = ability to create nukes
* US does not reprocess meaning it currently does not have capacity to proliferate – it stopped that in the 70s and instead guards waste until it can be disposed of
* HALEU is uranium enriched between 5-20%

For safeguards purposes, enriched uranium is categorised by enrichment level in two categories: LEU – less than 20 percent U-235; and highly enriched uranium (HEU) – 20 percent U-235 and above. Currently, typical LEU power reactor fuel is enriched up to 5 percent U-235. This is not a formal limit but is the result of practical and economic factors. HALEU’s higher enrichment level, compared with typical LEU, has a number of safeguards and non-proliferation implications. 1 Addressing these issues is not urgent, as the introduction of HALEU-fuelled power reactors is some years away and the likely numbers and locations of these reactors is not known. Also, technical characteristics of HALEU fuel and the costs involved are uncertain at this stage. Nonetheless, it is advisable to consider potential problems now so appropriate safeguards and institutional arrangements can be established in good time. 2. Safeguards and non-proliferation issues The potential challenges with HALEU related to safeguards and non-proliferation can be briefly outlined as follows: (1) Higher attractiveness for diversion. This relates primarily to the possible diversion of HALEU as feedstock for high enrichment. However, a recent paper has also raised the possibility that HALEU could be used directly for a nuclear explosive device.2 Whatever the practicability of this, the issue certainly highlights a major difference with HALEU compared with current LEU fuels. If HALEU is diverted for further enrichment to weapon-grade HEU (90 percent U-235 and higher), the enrichment effort required would be significantly less than using typical LEU. For example, to produce HEU at 90 percent enrichment using as feedstock HALEU at 19.75 percent enrichment would require little over 40 percent of the enrichment effort compared with using LEU at 5 percent enrichment (see section 3 following). 1. A good overview is Warren Stern et al, Implications for IAEA Safeguards of Widespread HALEU Use, Brookhaven National Laboratory, 2021, presentation to National Academies, https://www.nationalacademies.org/documents/embed/link/LF2255DA3DD1C41C0A42D3BEF0989 ACAECE3053A6A9B/file/D510EFD2C81FFF967900DB1152D2AB4D70DEBEFED05F?noSaveAs=1. 2. R. Scott Kemp et al, The weapons potential of high-assay low-enriched uranium, Science, 6 June 2024, https://www.science.org/doi/10.1126/science.ado8693. 2 (2) Economic incentive to reprocess. The higher residual enrichment of spent HALEU, compared with spent LEU, could change the economics of reprocessing. As shown in the Annex to this paper, preliminary analysis suggests reprocessing HALEU could be economically attractive. Whether this is in fact the case will depend on the cost of reprocessing, which in turn will depend on practical aspects, especially burnup levels (affecting the proportion of fission products in spent fuel) and whether the higher fissile content of spent HALEU fuel causes significant complications in reprocessing HALEU. If reprocessing HALEU is viable, this would raise the following considerations: (a) nuclear latency issues, if new reprocessing plants are established in states that do not currently reprocess (currently the only non-nuclear-weapon State with a commercial reprocessing facility is Japan); (b) diversion risk for HALEU recovered for re-enrichment and for separated plutonium (assuming plutonium separation from HALEU is undertaken – see section 4 below). Major factors affecting questions of risk include the type of fuel and the type of fuel cycle involved. For example, currently there is no practical technology for reprocessing TRISO fuel.3 Currently, therefore, TRISO fuel is seen as presenting low proliferation risk. If in-line recycling is used, the diversion risks are different to those for current reprocessing operations and output. Acquisition path analysis would have to be based on the specific design of the reactor and associated processes. 3. Enrichment The following is an approximate comparison of the enrichment effort needed to produce one safeguards significant quantity (SQ) of weapon-grade HEU using feedstock of natural uranium, LEU and HALEU. As defined by the International Atomic Energy Agency (IAEA) for safeguards purposes, an SQ is a quantity of HEU containing 25 kilograms U-235. For the following calculations, weapongrade is defined as 90 percent U-235 (one SQ of HEU at 90 percent enrichment is approximately 27.8 kilograms of total uranium). The metric for enrichment effort is the SWU – separative work unit. Calculation of enrichment effort depends on the assumptions made, including: • The ratio between feed material available and planned/acceptable tails assay (depleted output); • The number of enrichment stages required; • Enrichment levels – figures used here are 5 percent U-235 for LEU and 19.75 percent U-235 for HALEU. Based on these figures, to produce one SQ of weapon-grade HEU: • Starting with natural uranium requires an enrichment effort of 5,370 SWU.4 • Starting with LEU enriched at 5 percent U-235 requires 835 SWU, that is, around 16 percent of the effort required if starting with natural uranium. 5 3. TRISO is TRi-structural ISOtropic particle fuel. A TRISO particle is made up of a uranium, carbon and oxygen fuel kernel. 4. SWU rounded - based on feed of 6.1 tonnes natural U, tails assay 0.3%. 5. SWU rounded - based on feed of 815kg LEU at 5%, tails assay 2.0%. 3 • Starting with HALEU enriched at 19.75 percent requires 345 SWU, that is, around 42 percent of the effort required if starting with LEU, or just over 6 percent of the effort required if starting with natural U.6 The practical effect of a reduced requirement for enrichment effort is less installed capacity required, less time required, or both. It can be argued that the difference between using LEU and HALEU as enrichment feedstock is marginal compared with using natural uranium feed. While this is correct, a difference of almost 60 percent less effort required for enriching HALEU compared with LEU is significant and cannot be ignored. Current IAEA routine inspection plans for enrichment plants, and for LEU holdings, reflect a context in which LEU is enriched up to around 5 percent U-235. This gives certain calculated quantities for LEU that a state planning clandestine enrichment could seek to divert, and the scale of enrichment operations the state would need for this purpose. For states producing HALEU, or holding stocks of HALEU, the IAEA will need to take into account that the quantities of possible diversion significance are much smaller compared with LEU (or looked at another way, the potential breakout time will be much shorter). An issue for consideration is whether a new material category for HALEU, between LEU and HEU, is warranted. 4. Reprocessing and use of reprocessed uranium If HALEU enters into widespread use, it could change the currently unfavourable economics of reprocessing. This is because HALEU spent fuel will contain much higher levels of U-235 compared with spent LEU fuel, potentially making the uranium (which, depending on burnup, will comprise some 80 percent or more of the spent fuel) commercially attractive to recover. Unless there is a substantial increase in HALEU enrichment capacity (resulting in lower enrichment costs), reprocessing HALEU could be of interest both because it may be cost effective and because, as discussed below, it could help to meet HALEU demand. The cost of reprocessing. In considering the economics of reprocessing, the key metric is cost. Reprocessing costs are difficult to ascertain from readily available information, whether for current operations or for possible future reprocessing of HALEU fuels. Costs are affected by factors such as whether a reprocessing plant already exists or is yet to be built, the technology used, the scale (level of throughput) and so on. Depending on a number of variables, such as residual enrichment and burnup levels, spent HALEU fuel could have a fissile content (comprising residual U-235 plus produced plutonium) in the range of 7-10 percent, compared with typical spent LEU fuel at around two percent (comprising residual U-235 plus produced plutonium). This raises the question of whether criticality could present practical issues for reprocessing HALEU fuel. A higher fissile content could require a specially designed facility – the cost implications are not known. For the purpose of this paper it is assumed reprocessing costs for HALEU per unit of heavy metal will not be substantially different to those for LEU, but this assumption might prove to be optimistic. Another factor affecting reprocessing costs is the proportion of actinides and fission products in spent fuel. This is affected by the burnup level. In current light water reactor spent fuel the proportion of actinides and fission products is typically around 4 percent. As shown in the Annex to this paper, depending on the burnup level, the proportion of actinides and fission products in HALEU fuel could be as high as 24 percent, or possibly more. This would have a major effect on reprocessing economics. 6. SWU rounded - based on feed of 138kg HALEU at 19.75%, tails assay 2.0%. 4 In writing a 2016 paper on reprocessing the author found sources suggesting a range of reprocessing costs from $903 to $5,400 per kilogram of heavy metal (kg HM).7 The author settled on $2,500/kg HM as a reasonable indicative figure for the purpose of analysis. Applying inflation to the $2,500 figure suggests today’s equivalent would be around $3,200/kg HM. This is consistent with data in a 2019 French report which, after conversion from euros to US dollars and adjusted for inflation, indicates a similar figure. 8 Accordingly, for the purposes of this paper the figure of $3,200/kg HM is used. Reprocessing typical LEU fuel. The LEU fuel used today typically has an enrichment level of up to five percent U-235.In spent fuel the residual enrichment is less than one percent U-235 (say, 0.9 percent), which is little more than natural uranium. Applying the figure of $3,200/kg HM to reprocessing typical LEU fuel, the cost per kilogram of recovered product (uranium and plutonium), taking into account the actinide/fission product content (about four percent), is around $3,330 ($3,200 x 1.04). The value of the uranium is only a fraction of the cost of recovery. Each kilogram of this slightly enriched uranium costs $3,330 to recover, but the value in terms of its enrichment level is only around $435/kg.9 To reprocess 100 kilograms of spent fuel will cost $320,000; the value of the recovered uranium (94 kg x $435) will be about $40,000. Taking into account the value of the recovered uranium, the one kilogram of plutonium recovered from 100 kilograms of spent fuel effectively costs $280,000. These figures illustrate why reprocessing is totally uneconomic today. Reprocessing HALEU fuel. Compared with the current adverse economics of reprocessing, the major change with HALEU is that the value of the uranium, which will comprise 80 percent or more of the spent fuel, might make the uranium cost-effective to recover. Whether this is the case will depend, inter alia, on the initial enrichment level and the burnup level, which in turn will affect the residual enrichment level and the proportion of actinides and fission products. A number of scenarios are outlined in the Annex. If the residual enrichment level is around seven percent U-235, the recovered uranium (reprocessed uranium – RepU) could be recycled as standard LEU fuel without requiring re-enrichment, either directly or, if the residual enrichment is high enough, after down-blending to standard LEU levels (see parts 4 and 5 of the Annex). RepU could also be used as feedstock for re-enrichment to HALEU. This could be cost-effective if the residual enrichment level of the RepU is high enough (say over seven percent U-235), even taking into account the costs of compensating for the U-236 content. The presence of U-236 produced during irradiation is a complication in using RepU. This imposes additional costs in recycling uranium. Uranium-236 is not fissile, so it is undesirable in fuel for thermal reactors, and it cannot be efficiently separated by centrifuge enrichment because the mass difference between U-235 and U-236 is too small. If RepU is re-enriched, U-236 will be split between the enriched and depleted streams, and additional separation effort (SWU) will be needed to reach the required U-235 level. Also, U-236 in enrichment feed will contaminate centrifuges and piping, possibly causing subsequently enriched (nonreprocessed) LEU or HALEU product to be off specification. Consequently, enrichment operators will want to limit enrichment of RepU to dedicated cascades – and are likely to seek an increased SWU price to compensate for this.10 7. John Carlson, The Case for a Pause in Reprocessing in East Asia: Economic Aspects, NTI, August 2016, https://www.nti.org/analysis/articles/case-pause-reprocessing-east-asiaeconomic-aspects/. 8. Cour des comptes, Downstream Nuclear Fuel Cycle, 2019, https://www.ccomptes.fr/sites/default/files/2023-10/20190704-rapport-aval-cycle-combustiblenucleaire.pdf. 9. The figure of $435/kg is calculated on the basis of enriching natural uranium to 0.9 percent enrichment, taking account of costs for natural uranium feed, conversion and SWU. 10. Note however that if laser enrichment is commercially established, a laser process may be able to separate U-236 from RepU. 5 Another issue with using RepU, particularly for enrichment, is the presence of U-232, a decay product derived from neptunium-237 (via plutonium-236). Uranium-232 daughter products are strong gamma emitters, so precautions will be required to limit radiation exposure of personnel. This would add to costs. The greatest challenge associated with reprocessing HALEU appears to be the actinide/fission product content, which is expected to be much higher than with current LEU fuels due to higher burnup. This would have a marked impact on reprocessing cost. If the actinide/fission product content is say 24 percent, then effectively the cost per kilogram for recovered product (uranium and plutonium) will be $3,200 x 1.31, that is, around $4,200/kg. The calculations in the Annex suggest this figure could still be economic in some scenarios, though this is far from certain. Issues to consider with reprocessing HALEU include: (1) Should the plutonium in the spent fuel be separated or left as a uranium-plutonium mix? Plutonium could be separated in reprocessing and used to produce MOX (mixed uranium and plutonium oxides) fuel, as done in current reprocessing programmes. Another possibility would be to leave the plutonium in the product stream, which would then comprise a uranium-plutonium mix.11 Depending on the enrichment level of the uranium, retention of the plutonium could help to overcome the disadvantage of having a U-236 content. Depending on burnup, the plutonium content in spent HALEU fuel could be around two percent. This plutonium is likely to comprise around 60 percent fissile isotopes, so retaining the plutonium in the recovered uranium product would effectively be equivalent to an additional one percent enrichment. (2) What to do about the U-236 content in reprocessed uranium? This could be addressed in two ways: (a) One approach is to reprocess HALEU that has a sufficiently high residual enrichment level to compensate for the contained U-236. For example, if the residual enrichment is seven percent U-235, and the U-236 content is two percent, the effective enrichment level will be around five percent. 12 As noted in the Annex (part 4), a potential policy issue raised by compensating for U-236 in the enrichment of RepU is that if an effective enrichment level at the top of the HALEU range (say 19.75 percent) is sought, this would require enriching to slightly above 20 percent U-235. This would cross the threshold of the HEU category. The implications of this require further study. (b) An alternative approach is blending the RepU with fresh (i.e. non-irradiated) LEU to dilute the U-236 content. The proportions would depend on the enrichment level and U-236 content of the RepU, but something in the order of four-to-one (four parts of fresh LEU to one part of RepU) could reduce the U-236 to an acceptable level. Here too retention of plutonium in the mix would increase the fissile content of the blend. 11. An example is the Russian REMIX fuel concept, where plutonium remains with the RepU product and the fissile content of the mix is adjusted through blending with unirradiated enriched uranium. 12. Also, as noted above, retention of plutonium with the uranium would have a similar effect to an additional one percent enrichment. So a residual enrichment of six percent, together with the plutonium, would have a combined fissile content of seven percent, allowing for a U-236 content of two percent. This would correspond to an effective enrichment level of 5 percent. 6 5. Conclusions An increase in the number of states producing HALEU, holding HALEU stocks and fabricating HALEU fuel, and an increase in movements of HALEU, all have implications for safeguards. This could require adjustments in the frequency and intensity of safeguards inspections, and could also lead to the conclusion that safeguards should be supplemented by additional technical measures13 and institutional measures (such as control and ownership arrangements) to reduce proliferation risk. It is possible that reprocessing HALEU could be attractive both on cost grounds and to help meet increasing HALEU demand. The likelihood of this is difficult to assess at this stage. Deployment of SMRs and advanced reactors in significant numbers is still years away – meanwhile enrichment capability may expand, leading to lower enrichment prices, so the incentive to reprocess may diminish. Currently it is difficult to find the real costs of current reprocessing operations, there are subsidies and hidden costs. There is no common standard for “economic” operations – states are prepared to absorb costs in the interest of research and development. It is notable that some states have proceeded with current reprocessing operations despite the adverse economics. A concern is whether some states may be prepared to overstate the economic case for reprocessing in order to justify establishing a dual-use fuel cycle capability. Governments and the IAEA need to start considering how best to deal with this situation – the possibility of new reprocessing projects is problematic, even if the plutonium is not recovered as a separate product. Some reactor designs and fuel concepts would enable recycling without current forms of reprocessing, but any spread of capabilities that could assist clandestine separation needs to be dealt with very cautiously. Accordingly, the safeguards and non-proliferation implications of HALEU should be assessed in the near term so an appropriate control regime, if required, can be established in time to be effective. An important part of future fuel cycle arrangements is likely to be suppliers taking responsibility for dealing with spent HALEU fuel. To address the various concerns touched on here, it may be time to develop a multilateral approach to proliferation-sensitive aspects of the fuel cycle.

#### Tech gets exported globally.

Edwin Lymann, 03-18-2021, "Advanced" Isn't Always Better, Union of Concerned Scientists, <https://www.ucs.org/resources/advanced-isnt-always-better> [Before joining UCS, Dr. Lyman was president of the Nuclear Control Institute, a Washington, D.C.-based organization focused on nuclear proliferation. From 1992 to 1995, he was a postdoctoral research associate at Princeton University’s Center for Energy and Environmental Studies (now the Science and Global Security Program). He earned a doctorate degree in physics from Cornell University in 1992. Edwin Lyman is an internationally recognized expert on nuclear proliferation and nuclear terrorism as well as nuclear power safety and security. He is a member of the Institute of Nuclear Materials Management, and has testified numerous times before Congress and the Nuclear Regulatory Commission.] DOA: 3/12/2025 //RRM

One characteristic that UCS did not consider here is the ability of reactors to provide high-temperature process heat for industrial applications—sometimes cited as a major advantage of NLWRs. However, potential industrial users have demonstrated little interest in these applications to date, and will likely continue to be wary of co-locating nuclear power plants at their facilities until outstanding safety, security, and reliability issues are fully addressed. It is also doubtful that industrial users would want to assume the cost and responsibility of managing the reactors’ nuclear wastes. Consequently, UCS regards the generation of high-temperature process heat as a secondary objective that would first require significant improvements in nuclear safety and security.3 Safety and security risk is the vulnerability of reactors and fuel cycle facilities to severe accidents or terrorist attacks that result in significant releases of radioactivity to the environment. Routine radioactive emissions are also a consideration for some designs. The UCS assessment primarily used qualitative judgments to compare the safety of reactor types, because quantitative safety studies for NLWRs with the same degree of accuracy and rigor as for LWRs are not yet available. Far fewer data are available to validate safety studies of NLWRs than of LWRs, which have accumulated a vast amount of operating experience. Sustainability, in this context, refers to the amount of nuclear waste generated by reactors and fuel facilities that requires secure, long-term disposal, as well as to the efficiency of using natural (mined) uranium and thorium. Sustainability criteria can be quantified but typically have large uncertainties. To account for those uncertainties, this report considers that sustainability parameters, such as the amount of heat-bearing transuranic (TRU) elements requiring long-term geologic disposal, would have to improve by a factor of 10 or more to be significant. Nuclear proliferation and nuclear terrorism risk is the danger that nations or terrorist groups could illicitly obtain nuclear-weapon-usable materials from reactors or fuel cycle facilities. LWRs operating on a once-through fuel cycle present relatively low proliferation and terrorism risks. However, any nuclear fuel cycle that utilizes reprocessing and recycling of spent fuel poses significantly greater nuclear proliferation and terrorism risks than do LWRs without reprocessing, because it provides far greater opportunities for diversion or theft of plutonium and other nuclear-weaponusable materials. International safeguards and security measures for reactors and fuel cycles with reprocessing are costly and cumbersome, and they cannot fully compensate for the increased vulnerability resulting from separating weapon-usable materials. Also using HALEU instead of less-enriched forms of LEU would increase proliferation and terrorism risks, although to a far lesser extent than using plutonium or uranium-233. Nuclear proliferation is not a risk in the United States simply because it already possesses nuclear weapons and is designated as a nuclear-weapon state under the Nuclear Non-Proliferation Treaty. As such, it is not obligated to submit its nuclear facilities and materials for verification by the International Atomic Energy Agency (IAEA), although it can do so voluntarily. However, US reactor development does have implications for proliferation, both because US vendors seek to export new reactors to other countries and because other countries are likely to emulate the US program. The United States has the responsibility to set a good international example by ensuring its own nuclear enterprise meets the highest nonproliferation standards.4 Not all these criteria are of equal weight. UCS maintains that increasing safety and reducing the risk of proliferation and terrorism should take priority over increasing sustainability for new reactor development at the present time. 6 union of concerned scientists Given that uranium is now cheap and abundant, there is no urgent need to develop reactors that use less. Even so, there would be benefits from reducing the need for uranium mining, which is hazardous to workers and the environment and historically has had a severe impact on disadvantaged communities. Developing more efficient reactors may become more useful if the cost of mined uranium increases significantly, whether due to resource depletion or strengthened protections for occupational health and the environment. UCS also did not consider the potential for NLWRs to be more economical than LWRs. Although economics is a critical consideration and is interrelated with the criteria listed above, such an evaluation would depend on many open and highly uncertain issues, such as final design details, future regulatory requirements, and supply chain availability. Assessments of NLWR Types UCS has reviewed hundreds of documents in the available literature to assess the comparative risks and benefits of the three major categories of NLWR with respect to the three evaluation criteria (Table 2)

#### Risks are low now but terrorists are looking into it.

DHS, xx-xx-2025, “Homeland Threat Assessment 2025”, Office of Intelligence and Analysis, <https://www.dhs.gov/sites/default/files/2024-10/24_0930_ia_24-320-ia-publication-2025-hta-final-30sep24-508.pdf> [The Department of Homeland Security is a government organization dedicated to maintaining national security. It has the most up-to-date analysis of potential threats and is constantly working to tame them.] DOA: 3/24/2025

• Following ISIS’s loss of territorial control in the Middle East in 2019 and three of its most senior leaders in 2022, ISIS’s branches have taken a greater role in conducting operations on behalf of the group. ISIS-Khorasan (ISIS-K)—ISIS’s regional branch in Afghanistan and Pakistan—has been increasingly active outside of Afghanistan this year and will likely try to capitalize on its notable 2024 attacks in Iran and Russia to recruit followers in the Homeland and the West, as well as inspire individuals to mobilize to violence. These attacks, which killed more than 95 and 140 people, respectively, were the first major attacks conducted outside of the group's traditional operating area in several years, and were the most recent examples of ISIS-K’s successful recruitment of Central Asian supporters for attacks abroad. ISIS-K’s online media, particularly its multilingual Voice of Khurasan magazine, continues to emphasize the group’s intent to reach global audiences and galvanize supporters among Central Asian communities, including diaspora populations in other countries. ISIS online media groups have also used the Israel-HAMAS conflict to encourage attacks against the West and Jewish and Christian communities, and ISIS media outlets have capitalized on recent attacks in Europe to inspire more violent action. • Al-Qa‘ida remains committed to striking the Homeland and has reinvigorated its outreach to Western audiences. In December 2023, al-Qa‘ida’s affiliate in Yemen released its first Inspire-branded video and the first Inspire publication since 2021, which encouraged attacks against civil aviation and prominent individuals, urged retaliation against the West for supporting Israel, and provided bomb-making instructions. Al-Qa‘ida has also been inspired by the HAMAS attack against Israel and directed its supporters to conduct attacks against the Homeland, Jewish targets, and Israel. 4 Homeland Threat Assessment 2025 • Iran maintains its intent to kill US government officials it deems responsible for the 2020 death of its Islamic Revolutionary Guards Corps (IRGC)-Qods Force Commander and designated foreign terrorist Qassem Soleimani. In August 2024, a Pakistani national with ties to Iran was indicted for a planned assassination of US government officials. In June 2023, the US Department of the Treasury designated six IRGC members for their role in assassination plots targeting former US government officials, dual US and Iranian nationals, and Iranian dissidents. Chemical, Biological, Radiological, and Nuclear (CBRN) Threats To Endure 5 U.S. Department of Homeland Security We expect predominantly aspirational and rudimentary interest in CBRN attacks will continue in 2025. Among foreign and domestic threat actors, we assess that DVEs and criminals will remain the most likely perpetrators of deliberate CBRN-related attacks. Over the last year, there were 18 known deliberate chemical- or biological-related incidents in the Homeland, four of which were linked to political or ideological motives while the rest were criminal in nature. All of the incidents employed simple methods, and one incident caused at least one death. Two of the 18 incidents involved the alleged use of ricin, while 14 of the incidents employed easily obtainable chemicals—including a range of pesticides, chlorine, bear spray, and other chemical irritants. Fentanyl was weaponized in two instances. Foreign and domestic threat actors maintain aspirational interest in radiological and nuclear attacks, but these attacks remain unlikely. We expect threat actors will continue to explore emerging and advanced technologies to aid their efforts in developing and carrying out chemical and biological attacks. Over the last year, foreign and domestic extremists online expressed interest in using DNA modification to develop biological weapons to target specific groups. We remain concerned about the potential exploitation of advances in artificial intelligence (AI) and machine learning to proliferate knowledge that supports the development of novel chemical or biological agents. (For more information on AI and threat actors, see pages 26–27.) Such advances could be exploited by state and state-sponsored adversaries, but the necessary expertise for such exploitation most likely exceeds that of most nonstate actors. We also remain concerned about the potential for threat actors to use unmanned aircraft systems (UAS) in chemical or biological attacks due to the continued advancement of UAS technology and the growing availability of UAS. 6 Homeland Threat Assessment 2025 Illegal Drugs We expect illegal drugs smuggled into and sold in the United States will continue to kill more Americans than any other harmful security threat. Drug consumption kills tens of thousands of Americans each year, although drug overdoses tracked by the Centers for Disease Control and Prevention declined in 2023 for the first time since 2018. While fentanyl seizure volumes are significantly below those of methamphetamine and cocaine, fentanyl remains a top concern due to its potency, lethality, and availability.11 Fentanyl seizures have declined this year from record high seizures in FY 2023, but still remain elevated. DHS still seized enough fentanyl to kill the entire American population many times over. Criminal actors and criminal drug manufacturers are responding to increased US and partner nation efforts targeting the precursor chemicals needed for fentanyl production by modifying existing chemicals and substituting different chemicals in their drug compositions. Criminals also are adapting their smuggling methods to circumvent US customs regulations aimed at blocking the import of these chemicals and drug manufacturing equipment into the United States. US Customs and Border Protection (CBP) in FY 2024 year-to-date has also seized more methamphetamine at the US-Mexico border than in all of FY 2023, and we noted small increases in overdoses related to both cocaine and methamphetamine

#### European prolif risks nuclear war – entanglement, miscalc, and arms races.

Dr Tytti Erästö, 12-5-2023, "More investment in nuclear deterrence will not make Europe safer", SIPRI, <https://www.sipri.org/commentary/essay/2023/more-investment-nuclear-deterrence-will-not-make-europe-safer> [Dr Tytti Erästö is a Senior Researcher in the SIPRI Weapons of Mass Destruction Programme, focusing on nuclear disarmament and non-proliferation issues. Her recent and current research focuses on the Iran nuclear deal, the Nuclear Non-Proliferation Treaty, the Treaty on the Prohibition of Nuclear Weapons, the U.S./NATO-Russia dispute over missile defence, international efforts at establishing a WMD free zone in the Middle East, as well as other issues related to nuclear arms control. Previously she has worked at the Ploughshares Fund in Washington D.C., Harvard Kennedy School’s Belfer Center for Science and International Affairs, the Vienna Center for Disarmament and Non-Proliferation, and the Tampere Peace Research Institute in Finland.] DOA: 3/23/2025 //RRM

In contrast to NATO’s conventional power and the USA’s strategic nuclear forces, the US non-strategic nuclear weapons under NATO nuclear sharing arrangements do not constitute a credible means of deterrence. Although the replacement of older DCA with F-35s increases the likelihood of penetrating the adversary’s air defences in the case of a NATO nuclear strike against Belarus or Russia, a decision to do so would require not only authorization by the US and UK heads of state but also consensus among the alliance’s Nuclear Planning Group. This would mean an unlikely agreement among a group of 30 European democracies to order the first use of nuclear weapons or to respond in kind to a nuclear strike, thus engaging in nuclear warfare. Even if the allies could reach such a decision, any effort by NATO to control escalation would be undermined by the vulnerability of allied air bases to Russian counterforce attacks. Russia has thousands of nuclear weapons that it could use to destroy these bases, even after successful NATO strikes on Russian territory. The expansion of the existing nuclear sharing model to include new countries therefore makes little sense as a means to strengthen deterrence. Apart from further fuelling tensions, a new nuclear weapon base in Poland would add one more location to the adversary’s list of targets during a potential nuclear war. Insofar as US nuclear weapons in Poland would contribute to deterrence, this would have little to do with the weapons themselves and would rather derive from the American boots on the ground that would come with the B-61 package. Addressing the survivability problem through dispersal Reflecting a partial recognition of the credibility problem described above, discussions are happening behind closed doors within NATO on ways to increase the survivability of non-strategic nuclear forces. The debate seems to be focused on a ‘dispersal’ strategy, whereby US non-strategic nuclear forces would be spread across a greater number of European locations during crises, thereby complicating counterforce targeting for the adversary. An IISS report from September this year also discusses the idea. As a more viable alternative to peacetime nuclear weapon deployments in Poland, it suggests that NATO could ‘designate several Polish airfields as potential Dispersed Operating Bases’ to provide ‘additional options for dispersing dual-capable aircraft in wartime and in near-war situations’. It further suggests that, even if Poland did not host B-61 bombs, the Polish F-35s could be certified to deliver such weapons, and that similar measures could be taken in other member states. Until now, only those US allies that host nuclear weapons have been authorized to operate DCA under NATO nuclear sharing arrangements. There are indications that some elements of a dispersal strategy are already being implemented in the UK, which maintains a national sea-based strategic nuclear deterrent but does not possess non-strategic nuclear weapons of its own. As reported by the Federation of American Scientists, US Air Force budgetary documents imply that, 15 years after the withdrawal of US non-strategic nuclear weapons from the UK, the nuclear weapon storage facility at RAF Lakenheath airbase is being upgraded. Noting denials by US officials of plans to redeploy US nuclear weapons on UK soil, the FAS report notes that the base could ‘potentially receive nuclear weapons in the future or in the midst of a crisis, without necessarily having already decided to permanently station them’. The report also points to construction projects at other hosting states’ nuclear weapon bases that are ‘designed to facilitate the rapid movement of weapons on- and off-base to increase operational flexibility’. Depending on the extent to which it is implemented, the dispersal strategy would indeed complicate targeting for the adversary by creating uncertainty about the location of NATO nuclear forces. However, in practice Russia can be expected to hedge against this uncertainty by expanding the list of European targets during a hypothetical nuclear war to also include potential rather than just known nuclear weapon facilities, thereby exposing a bigger portion of the European continent to the devastating effects of nuclear explosions. Moreover, dispersal does not remove the main factor undermining the credibility of NATO’s non-strategic nuclear threats, which is that a large group of European democracies can hardly be expected to take a unanimous decision to turn their continent into a theatre of nuclear war. Calls for new nuclear weapons in Europe In recent years, several commentators have argued for the reintroduction of land-based intermediate-range missiles to Europe. These sub-strategic weapons—with a range of 500–5500 kilometres and thus seen as halfway between non-strategic and strategic weapons—were banned by the 1987 Intermediate-Range Nuclear Forces (INF) Treaty, from which both Russia and the USA withdrew in 2019. Noting that the treaty only came about after NATO’s 1983 deployment of nuclear-armed intermediate-range missiles, which was a response to earlier Soviet SS-20 deployments, proponents argue that a similar move today could push Russia to the arms control table. However, this historical analogy hardly stands up to scrutiny. The INF Treaty was the result of several fortunate conditions that happened to align at the time. These included the personalities of the Soviet and US leaders, their shared ambition to pursue nuclear disarmament, and the perception of symmetry in intermediate-range capabilities, creating a mutual interest in their elimination. The prospects of recreating such circumstances today are slim. Instead, a more likely result of European intermediate-range missile deployments would be a reciprocal Russian response, which would further worsen regional arms race dynamics. Even if armed with conventional warheads, as some have proposed, intermediate-range missiles involve particular escalation risks due to the combination of their ability to strike deep into an adversary’s territory and the difficulty of distinguishing between nuclear and conventional warheads during a crisis. A more authoritative proposal for new nuclear weapons in Europe, the October report by the Congressional Commission on the Strategic Posture of the USA, recommends additional theatre nuclear capabilities in Europe that are ‘deployable, survivable, and variable in their available yield options’. Although the authors are not explicit about what weapon types they have in mind, recent US debates suggest that these could include land-based intermediate-range missiles and nuclear-armed sea-launched cruise missiles (SLCM-N). Unlike the dispersal strategy, which would not involve changes in peacetime nuclear weapon deployments and might therefore not provoke major public reaction, nuclear force build-up involving new nuclear weapons would be a hard sell in Europe. This is especially true if new land-based missiles were to be introduced to the continent. Deployment of SLCM-Ns on US attack submarines would be less visible and thus also less controversial among allied countries. It would nevertheless pose a challenge for US relations and military cooperation with those NATO members (such as Denmark and Norway) that do not allow the transit of nuclear weapons through their territory or visits by nuclear-armed vessels at their ports. As US critics point out, SLCM-Ns, if deployed, would also increase escalation risks and worsen arms race dynamics by triggering responses from US adversaries. Moreover, given that the US strategic arsenal already provides options for tactical nuclear weapon use, it is hard to see the added deterrence value of the proposed new theatre nuclear weapon deployments. The need for a long-term perspective on European security Despite NATO’s military superiority over Russia, a feeling of insecurity persists in Europe, which can make analysts and government officials receptive to proposals to increase reliance on nuclear weapons. In addition to Russia’s actions in Ukraine, this can partly be explained by the nature of conventional deterrence. While there is no doubt that nuclear threats, if carried out, would lead to unacceptable damage to the adversary, the effects of using conventional force are more difficult to predict. This is because the ability to wage a conventional war depends not only on military capabilities but also on other factors such as strategy, tactics and morale. Moreover, information on the existing conventional forces is scattered and not easily available, which complicates comparative assessments and arguably contributes to the tendency to underestimate NATO’s relative power compared to Russia. Another factor highlighting the sense of insecurity in Europe is that Russian nuclear threats have exposed Europe’s vulnerability to nuclear weapons for the first time since the end of cold war. US strategic signalling and plans to strengthen NATO’s non-strategic nuclear forces have reassured its European allies, but they have also contributed to the illusion that Europe’s vulnerability to Russian nuclear weapons could somehow be reduced by greater investment in nuclear deterrence. In reality, as suggested above, the strategy of dispersing nuclear weapons during crises would only make nuclear war in Europe more devastating, while deploying new nuclear weapons could make such a war more likely. Instead of a futile quest for absolute security, Europeans should recognize the strength of NATO’s existing conventional forces, which can temper worst-case assumptions about Russian aggression against NATO. The downside to the prevailing power imbalance in Europe’s favour is that Russia will likely continue its greater reliance on nuclear weapons while it rebuilds its conventional forces. There is, however, no military solution to this problem. Ultimately, threat perceptions on both sides need to be addressed through the creation of a more sustainable regional security order that not only ensures sovereignty for Ukraine and other countries that might fall victim to Russian aggression but also reduces Russia’s exaggerated threat perceptions of NATO. While this seems unachievable under the current Russian leadership, tensions could be managed in the short term by promoting stability at the NATO–Russian border. Norway’s longstanding self-imposed restrictions on allied overflights and military exercises in its northern territory near the Kola Peninsula provide one model that could be extended to NATO’s new Nordic members—notably Finland, whose more permissive policy on allied overflights may undermine the Norwegian restrictions.

#### Prolif collapses global governance.

Michael Moodie and Jerry Zhang, 10-31-2022, "Bolstering Arms Control in a Contested Geopolitical Environment • Stimson Center", Stimson Center, <https://www.stimson.org/2022/bolstering-arms-control-in-a-contested-geopolitical-environment/> [Mr. Moodie is currently an Associate Fellow of the Royal Institute of International Affairs (Chatham House) in London and Secretary of the Board of Trustees of the Wilton Park US Foundation. In academia, Mr. Moodie has had appointments as Visiting Professor at Georgetown University’s School of Foreign Service and George Mason University, and as an Instructor at Chestnut Hill College. Mr. Moodie was educated at Lawrence University in Appleton, Wisconsin and the Fletcher School of Law and Diplomacy, Tufts University. Jerry Zhang is a Master’s student at Georgetown University’s Walsh School of Foreign Service where he focuses on science, technology, and international affairs. He interned at the Stimson Center’s Global Governance, Justice and Security Program after graduating from Tufts University in 2021.] DOA: 4/2/2025 //RRM

The evolving global environment, then, is almost certain to be more contentious, perhaps dangerously so, with nations locked in heated rivalries over trade, technology, diplomatic influence, and competing national security interests, to say nothing of potential military confrontations. A military conflict between China and the U.S. over Taiwan, for example, is no longer an unthinkable scenario.25 This more adversarial geostrategic environment brings the world to the brink of a destabilizing arms race and complicates the prospect of multilateral cooperation on arms control. Coming under such severe pressure, global arms control will be challenged significantly to play its traditional role as a crucial contributor to global governance.

The need for global arms control

In this environment, arms control could become a crucial tool for promoting global security and stability. Successful cooperation in arms control is not only in the long-term economic and strategic interests of leading countries, but it can also serve to strengthen global governance. By contrast, the failure to reinvigorate arms control might only intensify competitive stresses with potential implications for the norms and institutions that are core components of the international system.

First, arms control can contribute to a more stable and predictable relationship between the great powers. While arms control will not halt U.S. strategic competition with Russia, China, or others, it could dampen its most dangerous aspects. Historically, U.S.-Soviet arms control arrangements, such as the Strategic Arms Limitation Talks (1969-1979) or the Intermediate-range Nuclear Force Treaty (1987), helped to foster détente and a modus vivendi in their relations. Arms control provided a mechanism for confidence-building and crisis-management by creating valuable personal and organizational relationships and helping officials better understand each other’s approaches. This was the case not only bilaterally but multilaterally through entities like the Conference (now Organization) for Security and Cooperation in Europe (C/OSCE). 26

Second, arms control can strengthen strategic stability by avoiding an intensifying arms race that locks rivals into an indefinite cycle of arms expansion and fosters greater insecurity with increased chances for miscalculation. Arms races, moreover, are expensive, absorbing immense financial, technological, and human resources. Keeping military expenditure under control is in the economic interests of every party, whether their economies have been hurt by the pandemic as in the U.S., or they have noticeably slowed in recent years as in China.27 One reason that arms control garners support among politicians and the public is that resources spent on an arms race could have been devoted to other efforts such as fighting climate change or helping post-pandemic reconstruction in the developing world.

Third, arms control can also mitigate the negative impacts of the proliferation of advanced weaponry. As emerging technologies become more accessible, the risk also grows that they will fall into the hands of terrorists, criminals, warlords, or other malign actors.28 In the conventional weapons sphere, drones, which used to be state-of-the-art, are now being used not just by military forces but by non-state actors in such places as Syria, Libya, and Yemen.29lethal autonomous weapons, could exacerbate competition and make conflicts more destructive.

Finally, arms control can diminish the risks of war through accident and miscalculation. The Cold War witnessed a number of close calls, be it the Cuban Missile Crisis or the war scare over the 1983 Able Archer exercise. Although the world has escaped the catastrophe of an unintended nuclear war thus far, in the future nothing is guaranteed. The advance in disruptive technology further increases such a risk: cyber-attacks might escalate into a nuclear exchange, and plausible scenarios can be conceived in which the possible exploitation of artificial intelligence in future chains of command plunges the world into a devastating war by error.30

#### Independently,

Nick Beckstead and Toby Ord, xx-xx-2014, “Innovation: managing risk, not avoiding it”, Future of Humanity Institute, <https://www.fhi.ox.ac.uk/wp-content/uploads/Managing-existential-risks-from-Emerging-Technologies.pdf> [Toby Ord is a Senior Researcher at Oxford University. Toby has advised the United Nations, the World Health Organization, the World Economic Forum, and the UK Prime Minister’s Office. Beckstead worked as Policy Lead at the Center for AI Safety and as CEO of the Future Fund, along with various consulting projects. I was also a research fellow at Oxford University's Future of Humanity Institute. I completed a bachelor's degree in mathematics and philosophy from the University of Minnesota and a Ph.D. in Philosophy at Rutgers University.] DOA: 4/2/2025 //RRM

Many concerns have been expressed about the¶ catastrophic and existential risks associated with engineered¶ pathogens. For example, George Church, a pioneer in the¶ field of synthetic biology, has said:¶ “While the likelihood of misuse of oligos to gain access to¶ nearly extinct human viruses (e.g. polio) or novel pathogens¶ (like IL4-poxvirus) is small, the consequences loom larger¶ than chemical and nuclear weapons, since biohazards are¶ inexpensive, can spread rapidly world-wide and evolve on¶ their own.”10¶ Similarly, Richard Posner11, Nathan Myhrvold12, and¶ Martin Rees13 have argued that in the future, an engineered¶ pathogen with the appropriate combination of virulence,¶ transmissibility and delay of onset in symptoms would¶ pose an existential threat to humanity. Unfortunately,¶ developments in this field will be much more challenging¶ to control than nuclear weapons because the knowledge¶ and equipment needed to engineer viruses is modest in¶ comparison with what is required to create a nuclear¶ weapon14. It is possible that once the field has matured over¶ the next few decades, a single undetected terrorist group¶ would be able to develop and deploy engineered pathogens.¶ By the time the field is mature and its knowledge and tools¶ are distributed across the world, it may be very challenging¶ to defend against such a risk.¶ This argues for the continuing development of active¶ policy-oriented research, an intelligence service to ensure¶ that we know what misuse some technologies are being put¶ to, and a mature and adaptive regulatory structure in order¶ to ensure that civilian use of materials can be appropriately¶ developed to maximize benefit and minimize risk.¶ We raise these potential risks to highlight some worstcase scenarios that deserve further consideration. Advances¶ in these fields are likely to have significant positive¶ consequences in medicine, energy, and agriculture. They¶ may even play an important role in reducing the risk of¶ pandemics, which currently pose a greater threat than the¶ risks described here.

#### Effective governance is a prerequisite to solving existential risks.

Henry Willis et al., 10-30-2024, "Understanding and Managing Global Catastrophic Risk", RAND, <https://www.rand.org/pubs/research_briefs/RBA2981-1.html> [Willis earned his Ph.D. in engineering and public policy at Carnegie Mellon University, M.S. in environmental engineering from the University of Cincinnati, and B.A. in chemistry from the University of Pennsylvania. Naranyan: Ph.D. in engineering and public policy, Carnegie Mellon University; B.S. in applied mathematics, University of Texas at Austin. Boudreaux holds a Ph.D. in philosophy from the University of California, Berkeley, a M.S. in foreign service from Georgetown University, and a B.A. in economics and philosophy from NYU. Geist received his Ph.D. in history from the University of North Carolina. Gerstein graduated from West Point and has a Ph.D. from George Mason University and master's degrees from Georgia Tech, National Defense University, and Army Command & General Staff College. Espinosa has a PhD in Chemistry from USC and is a Doctor of Philosophy. Goldfeld received her Ph.D. in chemical physics from Columbia University where she was an NSF graduate fellow. Kalra holds a Ph.D. in robotics from Carnegie Mellon University’s Robotics Institute. LaTourrette holds a Ph.D. in geology from the California Institute of Technology. Lathrop has a PhD in robotics from UCSD.] DOA: 4/2/2025 //RRM

Common Factors Affecting All Six Sources of¶ Global Catastrophic Risk¶ Several common factors influence global catastrophic risk¶ from all six threats and hazards assessed in the RAND report:¶ • the rate and nature of technological change¶ • the maturity of global governance and coordination¶ • failure to advance human development¶ • interactions among the hazards themselves.¶ How these drivers evolve can determine how, how¶ seriously, and how swiftly the United States and countries¶ worldwide will need to respond to manage the risks. Plans¶ that reflect these drivers will be more robust to the uncertainties they create.¶ Figure 3 Quality of Evidence Supporting Risk Management and the Geographic Extent of¶ Global Catastrophic and Existential Risks¶ Geographic extent of consequences¶ Quality of evidence to support risk management¶ Intentional pandemics,¶ including those enhanced¶ with synthetic biology¶ Unaligned¶ arti­cial general¶ intelligence¶ Exceedance of¶ thresholds for key¶ global climate¶ risks¶ Global¶ nuclear war¶ Comets¶ Global¶ atmospheric effects of¶ a supervolcano¶ Natural pandemics¶ Caldera eruption¶ (local effects) Small asteroids¶ Climate change–enhanced¶ natural hazards¶ Medium-sized asteroids¶ AI’s effects on existing risks¶ Large asteroids¶ Regionalized Global¶ High¶ NOTE: The placement and sizes of the ovals in this figure represent a qualitative depiction of the relative relationships¶ among threats and hazards based on interpretation of aspects of the assessments described in the report. The figure¶ presents only examples of some cases and scenarios described. Artificial general intelligence generally refers to AI¶ systems that can do at least as well as humans can on cognitive tasks, handle unanticipated problems, and generalize¶ what they learn. A caldera is a large crater caused by certain kinds of volcanic eruptions. For more about these¶ concepts, see the main report.¶ Low¶ 8¶ Managing Global Catastrophic Risk¶ Aligning Risk Management to the Nature¶ of Specific Hazards¶ As noted above, the hazards and threats reviewed by¶ RAND can vary widely in terms of the geographic extent¶ over which consequences can be expected to occur and the¶ quality of understanding about their scope, likelihood, and¶ consequences. These two dimensions of risk, which are¶ plotted in Figure 3, influence the appropriateness of risk¶ management approaches.¶ For the threats and hazards with relatively wellunderstood effects and responses and where the geographic¶ scale of the consequences aligns with the appropriate risk¶ management jurisdictions (i.e., those in the lower left-hand¶ corner of Figure 3), FEMA, DHS more generally, and other¶ parts of the U.S. government could begin to organize useful¶ responses. For example, for small asteroids, the government could improve the National Aeronautics and Space¶ Administration’s (NASA’s) planetary defense capabilities¶ and improve capabilities for evacuation and civil defense.¶ Such evacuation and civil defense capabilities would also¶ Figure 4 Risk Management Intervention Opportunities¶ PREVENTING IMPACT REDUCING THE CONSEQUENCES¶ OF IMPACT¶ Reduce¶ severity of¶ effects¶ Enhance¶ response¶ and recovery¶ Reduce the¶ onset of the¶ threat or¶ hazard¶ Disrupt¶ mechanism¶ leading to¶ risk¶ 9¶ prove useful for the local effects of a supervolcano and for a¶ limited nuclear attack. Other events of this scale and relative¶ understanding can leverage existing planning frameworks,¶ such as the National Preparedness System and conventional¶ approaches to planning for continuity of government and¶ continuity of operations.¶ Addressing the risks in the other corners of Figure 3,¶ however, will require significant innovation to generate (1) the¶ capacity for currently unknown or unavailable responses,¶ (2) risk management approaches suitable for such deeply¶ uncertain risks, and (3) enhanced institutions at all levels¶ of governance (including internationally) able to implement¶ these risk management approaches. Such innovation could¶ also enhance risk reduction for the better-understood risks¶ in the lower left-hand corner of the figure.¶ The geographic scale of the consequences of a risk is¶ not the same as the geographic scale of the most-appropriate¶ responses to a risk. Many of the risks shown in Figure 3¶ might be best addressed with a coordinated global response¶ to most effectively prevent or address the consequences¶ regardless of where disaster strikes.¶ Risk Management Interventions¶ Because a global catastrophic risk management strategy¶ may include many different types of actions, thinking¶ broadly about opportunities to intervene to manage risks is¶ necessary (see Figure 4). For example, reduction or prevention of the onset of a threat or hazard might be possible.¶ When neither of those is possible or successful, opportunities could arise to disrupt the mechanisms that lead to¶ harmful consequences. Furthermore, there might be ways to¶ reduce the severity of effects should they occur. And, when¶ all else fails, options exist to recover from the effects.¶ Preventing Impact¶ As of early 2024, risk mitigation strategies targeted to¶ prevent catastrophic impact from the six assessed hazards¶ and threats spanned stages of development and capability.¶ Approaches for the least-mature cases are theoretical and¶ untested (e.g., draining heat from the magma chamber of a¶ supervolcano or in-space deflection of large impactor asteroids and comets). Also, some risk management approaches¶ Figure 5 Types of Approaches Available to Manage Global Catastrophic and Human Existential Risks,¶ by Mitigation Dimension and by Threat or Hazard¶ Reduce the¶ likelihood of¶ occurrence.¶ Disrupt the¶ mechanisms¶ leading to¶ the risk.¶ Reduce the¶ severity of¶ the effects.¶ Severe¶ Pandemic¶ Climate¶ Change Nuclear War Asteroid and¶ Comet Impact AI Supervolcanoes¶ Not¶ applicable¶ Governance and policy Technical and logistical Research and development¶ Enhance¶ response¶ and recovery.¶ 10¶ might be well studied, tested, and more mature but depend¶ on controlling human behaviors, such as curtailing greenhouse gas emissions or preventing nuclear war. In the case¶ of AI, both current and future threats remain uncertain.¶ Nevertheless, governmental and nongovernmental organizations have produced frameworks to help prevent the¶ deployment of systems that could cause harm, and the AI¶ community has proposed risk management strategies, such¶ as international technical standards, regulations, voluntary¶ self-regulation, and market pressures.¶ Reducing Consequences of Impact¶ Strategies to reduce the severity of hazard or threat impact¶ also vary but can closely align with existing emergency¶ preparedness frameworks when considering response and¶ recovery options. Even so, the most-salient approaches¶ should be determined by characteristics of the risks posed¶ by each hazard and threat. For example, reducing the consequences of climate change or nuclear war involves building¶ resilience in affected or potentially affected communities¶ through such actions as relocating at-risk populations or¶ building shelters. Preparing for a supervolcano or a large¶ asteroid impact can take a similar approach through evacuation planning. These approaches will require significant¶ investment in governments’ and communities’ research and¶ development of early-warning systems and preparedness¶ planning. With respect to reducing the severity of pandemics, recent examples of vaccine hesitation and mistrust¶ among the public show that government institutions will¶ need to improve strategic communication and work to build¶ trust with communities, in addition to pursuing accelerated¶ vaccine development and distribution.¶ Three Types of Risk Mitigation Efforts¶ As presented in Figure 5, investments in risk management¶ options can be grouped by the following three categories:¶ • taking action: Many risk mitigation efforts identified in the researchers’ assessments involve technical¶ or logistical measures that can be implemented to¶ prevent or reduce risks.¶ • governing: Some of the identified risk mitigation¶ options involve using regulations and laws, policies,¶ or norms to influence actions and behaviors in ways¶ that reduce risks.¶ • learning: For some hazards and threats, there might¶ not be options or enough knowledge about risks to¶ either act or govern, and research and development¶ are necessary before more-active steps can be taken.¶ Investments in risk management can¶ involve technical or logistical measures¶ to prevent or reduce risk, governance¶ and policy to influence actions and¶ behaviors to reduce risk, or research¶ and development if not enough is¶ known about the risk to take action.¶ 11¶ Technical and logistical approaches are most relevant¶ for those threats and hazards that are better understood¶ and for which solutions are readily available, such as managing the effects of nuclear detonations, natural hazards¶ exacerbated by climate change, and efforts involving public¶ warnings, evacuations, and incident response and recovery.¶ Although such solutions can directly reduce risk, they can¶ also be costly and require attention to planning and evaluation to ensure effective implementation.¶ Governance and policy approaches are relevant where¶ risks result from human behaviors and economic activity.¶ For example, regulations and policies can be established to¶ prevent or minimize the misuse or development of dangerous AI and biotechnology or to reduce emissions of carbon into the atmosphere. Governance approaches also include

# 2NC

## Off

#### 1] Yes new warrants – all debate is re-clarification and context for prior arguments – their interp justifies the constructives being read and the round ending because the rebuttal can make “infinite re-clarification” --- that would nullify the critical thinking and argument comparison skills for debate. This is a voting issue --- the overview is an interp that stakes out a model of debate --- if we win their model is bad for debate it outweighs spark. If you determine their model is good for debate, you should still vote for us because their answers to this argument are a re-clarification of their original argument, and therefore they have conceded this one.

#### 2] No warrant why introducing new warrants is a race to the bottom – it’s only 1 speech of new evidence & indicts question the study mechanism or qualification of one author; we can provide evidence with the same warrant but different study ideologies to prove that the consensus for the argument is still strong and studied.

## On

#### Try or die for civilization---absent tech humanity will die out from other catastrophes or from heat death.

Baum et al. 13 [Seth Baum; Global Catastrophic Risk Institute, Timothy M. Maher Jr.; Bard College - Center for Environmental Policy, Jacob Haqq-Misra; Global Catastrophic Risk Institute; March 23, 2013 “Double Catastrophe: Intermittent Stratospheric Geoengineering Induced By Societal Collapse” <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3640777>] brett

Global catastrophic risks are risks of events that would significantly harm or even destroy humanity at the global scale. As such, they are risks of the highest magnitude, regardless of probability. Global catastrophic risk has received considerable research interest over recent years.2 Global catastrophic risk is similar to the concept of existential risk, which refers more narrowly to risks to the existence of humanity (i.e. human extinction) or related events (Bostrom 2002; 2012). Another related concept is that of global survival, which refers to efforts to prevent or endure global catastrophes (Seidel 2003). A core reason for focusing on global catastrophic risk is because of its significance for expected value maximization. The moral foundations of risk analysis, cost-benefit analysis, and related paradigms are all rooted in some form of expected value maximization, in which the best actions are those that result in the largest expected value given uncertainty about the consequences of the possible actions. A global catastrophe would result in a large decline in value, with the largest declines coming from catastrophes that result in the permanent destruction of advanced technological civilization. Human extinction events are included here (Matheny 2007; Ng 1991). Also included are civilization collapses in which some humans are still alive but unable to ever rebuild civilization. Such a population would likely be smaller and more vulnerable to extinction by subsequent catastrophes. If nothing else, the population would go extinct when changes in the Sun render Earth uninhabitable in about five billion years, whereas a civilization with advanced technology could colonize space and survive for many orders of magnitude longer (Baum 2010; Tonn 2002). The scenario in Sect. 3 and decision analysis in Sect. 4 are heavily oriented toward the possibility of SAI double catastrophe causing permanent destruction of advanced technological civilization.

### Impact---Nuke War = Impossible to Survive- General

#### Impossible to survive. Also, this is their islands author.

Turchin & Green 18 Alexey Turchin – Scientist for the Foundation Science for Life Extension in Moscow, Russia, Founder of Digital Immortality Now, author of several books and articles on the topics of existential risks and life extension. Brian Patrick Green – Director of technology ethics at the Markkula Center for Applied Ethics, teaches AI ethics in the Graduate School of Engineering at Santa Clara University. <MKIM> “Islands as refuges for surviving global catastrophes”. September 2018. (PDF) Islands as refuges for surviving global catastrophes (researchgate.net) // ella

3. An island as a center of cultural and technological preservation after a weak catastrophe or a civilizational collapse As Jebari noted (Jebari, 2014), refuges are important not only to preserve the last members of the human species, but also for the preservation of important cultural heritage in form of a living tradition (e.g., our value system), and as centers of coordination for reconstruction in the case of global social collapse. Cultural preservation will be especially important if the appearance of complex technology is not a typical outcome within the evolution of human societies, but rather the result of one or dmore rare events. If this is true, then humanity could have been stuck indefinitely at the tribal or imperial levels, and perhaps even gone extinct were some dangerous global challenge to appear. Even if many people survived on land after a societal collapse, their social organization might be centered around looting the remains of the previous high-tech civilization, as happened in the first few centuries after Rome’s demise. As a result, they would not only lose the skills needed to create useful technologies, but also acquire a set of negative skills, based on scavenging, piracy, and violence. This would prevent their development towards recovery, until, at last, all technological remains were looted and all knowledge lost. It should be noted that after the fall of Rome this downward spiral was avoided by copying and preserving ancient knowledge with religious fervor. In other words, technological remains can paradoxically prevent the appearance of a new complex society, because it is always cheaper to scavenge and loot. This happened to some extent after the collapse of the Soviet Union, when selling factories and their contents for scrap was cheaper than re-starting manufacturing. In this case, even small societies which preserved effective social organization and an uninterrupted educational process could become seeds for the re-creation of technological civilization. Large islands, inaccessible to gangs of looters, could be such centers of reconstruction. They should have universities, high levels of human capital, adequate military defense, and abundant natural resources. Possible examples include New Zealand, Hawaii, Taiwan, Japan, and Iceland. If such islands could retain high levels of technology, over time they would gain an advantage over the gangs of looters on the continents. Their higher education would promote better healthcare, and better medicine could allow higher rates of population growth. In that case, the restoration of global technological civilization might take less than one millennium, and the new civilization might not be divided into conflicting countries. The island would be the main center of power, leading to a much more stable society with smaller risks of a new global catastrophe resulting from global war—though there also may be other surviving islands that are uncooperative. However, if there were no such place to support this hopeful outcome, gangs of looters could instead develop cruel empires in a state of constant war, and further catastrophes would occur. The cycle of collapse–development–destruction could repeat, each time with a smaller chance of full and stable recovery, as resource depletion and climate change made each future recovery harder, until the point of total extinction 4. Overview of a few islands as possible refuges Despite the fact that there may be as many as one million islands in the world, most of them will provide little or no protection. Only a few islands have the necessary conditions described in Section2.2. Here, a few potential island refuges are described and then compared in Table 1. 4.1. The Kerguelen Islands as one of the most suitable archipelagos for long term survival. One of the most attractive islands for long-term survival of global risks is the French archipelago of Kerguelen in the southern Indian Ocean. Kerguelen’s main Grand Terre island has the following attractive features for long-term survival: It is very remote from any other constant human settlements; for example, is it 3000 km from the island of Reunion. The Kerguelen Islands lie outside the main trade lines, so the probability of a random ship arriving there is low. The islands are inside the circumpolar Antarctic current, and they are surrounded by strong winds (the “Roaring Forties” and “Furious Fifties”), which will not accidentally bring any ships from further north. A return trip from Reunion to Kerguelen by ship takes 28 days. The islands do not have an airport, so they cannot be reached by air, and they are too remote for helicopter travel. While Easter Island is even more remote from other human settlements, it is more populated and more often accessed by ships and planes. The intense and isolating wind circulation around the South Pole could increase the time required for ash or radioactive clouds from the northern hemisphere to reach the South polar region. But the Kerguelen Islands are also not too close to the South Pole: they are at the equivalent latitude as southern Germany; thus, they get quite a bit of sunlight. The Kerguelen Islands have a stable but cold climate, with temperatures above freezing most of the time. The main island has edible vegetation and many edible animals, including 3000sheep. The island is very large, approximately 7000 km2, and it has many deep gulfs and fjords that could be used as harbors. The main island has high mountains (over 1000 m) with an ice cap which could provide fresh water. Nearby ice-free mountains hundreds of meters high could provide protection against tsunamis. The highest mountain is volcanic, and was active 100 000 years ago (Weis et al.,1998). However, residual geothermal heat could provide heating and energy for a refuge. The main island has a continuous population of only about 45 people, who live at a scientific station. Scientists who are selected for long expeditions are more organized and educated than random people, so they may be better prepared for survival. Such a scientific base will not be a military target in case of war. There are several other South Ocean islands similar to Kerguelen, like South Georgia, Auckland Island, and Macquarie Island (Schalansky, 2010).4.2. A “Martian base” on Devon Island Billionaire Elon Musk has suggested creating a “backup drive” for humanity on Mars, in the form of a self-sustaining settlement there (Devlin, 2017). However, there are places on Earth with very similar conditions to Mars and it may be reasonable to build a model for a Martian refuge first on Earth. These places could serve two purposes: practice for the settlement of Mars, and protection against global catastrophes. In fact, the beginnings of such a place already exists, at the Martian simulation base onDevon Island in Canada. The cold highland plateau in the middle of Devon Island is very similarto Martian conditions. Because of this it has become home to the Flashline Mars ArcticResearch Station (FMARS) (FMARS, 2018). FMARS is small, seasonal, and cannot supportitself by agriculture, but it is designed for survival in the harsh environment of a polar desert andis equipped with space suits, which could provide protection from certain types of catastrophes.For Devon Island to become a more robust potential refuge from a global catastrophe itwould need to be greatly expanded and developed into a self-sustaining community. This wouldnot be impossible, as the hamlet of Resolute, 165 km southwest, has been in existence since1947. As a scientific outpost for Mars simulation, Devon Island lends itself to this growth,because the knowledge gained from it will be of great importance to actual Mars exploration and settlement in the future. Importantly, if humanity is not able to build a self-sustaining base onDevon Island, it certainly will not be able to build one on Mars; therefore, it is worth trying. Devon Island is located on the opposite side of the Earth from Kerguelen, and in a localizedcatastrophe one of the islands will be less affected. Devon Island provides a different protectionprofile than Kerguelen. Kerguelen is more suitable for indefinitely long survival after a complexcatastrophe like a pandemic and social collapse, while Devon Island may be helpful for survivinga relatively short but intense event. 4.3. The case of New ZealandNew Zealand is located on large and remote islands. It has many natural resources and aneducated population, which could allow it possibly to independently support a high level ofcivilization without major technological loss, at the level of at least the mid-20th century (i.e.,without an advanced computer industry). This means that the total repopulation of the Earth, ifonly New Zealand survived, might take only several centuries without loss of knowledge duringthe new Dark Ages.New Zealand possesses high mountains (approx. 3700 m) which could remain safe in thecase of extreme tsunamis. However, New Zealand had a recent Taupo supervolcano eruption,only 26 000 years ago (Barker et al., 2014), and has continuing volcanic activity that may bedangerous for its inhabitants.New Zealand lacks strong air defense capabilities and might not be able to prevent the influxof airplanes with refuges, which could bring a dangerous pandemic to the nation. One solutionwould be to block runways so large planes could not land. There are several other large and remote islands under New Zealand’s control, includingAuckland Island to the south and Chatham Island to the east. Chatham has supported apopulation for over 1000 years (Department of Conservation, 1999), and so is a proven refuge. As mentioned above, many “high net-worth individuals” have already sought to establishproperties as refuges and shelters in New Zealand, though the efficacy of these “bolt-holes” isdebatable (Siler, 2017) and the local population has grown resentful of the idea of foreignersfleeing to their nation.4.4. Comparison of different islandsBased on the criteria listed in Section 2, 15 promising islands which could help humanitysurvive different types of catastrophes were selected; these islands are described in Table 1. [chart in original article] .5. Natural survival on unprepared islands The law of large numbers and randomness creates the probability that humans may stillsurvive in some unexpected places in the case of a catastrophe despite the lack of anypreparation. There have been survivors in head-on mid-air collisions of aircraft, in basementsnear the hypocenter of the Hiroshima nuclear explosion, and on pieces of wood in the ocean.Unexpected survivals are not uncommon.There are numerous examples of castaways surviving for long periods of time in isolation.New Zealander Tom Neale chose to live for 16 years on the coral island of Suwarrow in theCook Islands, which has area of just under 10 km2, and an Inuit woman survived alone on anArctic island for 2 years (Nati, 2014). The diversity of different islands provides protection from the diversity of potentialcatastrophes that may be faced. There are tens of thousands of potentially inhabitable islands in the world and they can be tropical or cold, large or small, populated or unpopulated, mountainous or flat, and so on. In some ways, islands can almost be viewed as like small planets.5. Comparison of different catastrophes and refuges Island refuges might be helpful only in the case of rather weak catastrophes, and to estimate their usefulness, island refuges were compared with other possible types of refuge. InFigure 1, correlation between different types of shelters (in red) and the size and duration of a catastrophe they could help humans survive. There are two main groups of shelters: one that aims to repopulate (or return to) Earth when conditions improve, and another that assumes that Earth will be rendered permanently uninhabitable. Islands provide protection for long, but weak catastrophes. Submarines and bunkers provide protection for shorter and more intense catastrophes. However, the combination of submarine, island, and underground refuge providethe best protection for all types of catastrophes in which Earth eventually returns to habitability.While Beckstead (Beckstead, 2015) thought that the gap between survival withoutrefuges and complete overkill catastrophes was too small, and therefore refuges were useless, onthe contrary, the quickly decaying tails on the probability distributions of catastrophes increase the chance that catastrophes may be survivable in refuges 6. Combining different refuge types to optimize protection on an island One of the weaker aspects of islands as refuges is their inability to withstand short, intense disasters, such as a nuclear war or bolide impact. The stronger aspect of an island is its ability to provide long-term protection and isolation from weaker but lingering “post-apocalyptic” effects, like a pandemic, radioactive contamination, looters, and lethal autonomous weapons systems run amok.

### Impact---Nuke War = Civ Collapse = Extinction

#### Even if not directly existential---that spurs system collapse AND pandemics, which are.

Cribb ’19 [Julian; October 3; author, journalist, editor and science communicator, principal of Julian Cribb & Associates who provide specialist consultancy in the communication of science, agriculture, food, mining, energy and the environment, more than thirty awards for journalism; Food or War, 6 - Food as an Existential Risk,” 1st ed., Cambridge University Press. DOI.org (Crossref), doi:10.1017/9781108690126]

Humanity is facing its greatest test in the million-year ascent of our kind. This isn’t a single challenge. It’s a constellation of huge man-made threats, now coming together to overshadow our civilisation’s stability and even, maybe, its future survival. These ten intersecting risks are: ecological collapse, resource depletion, weapons of mass destruction, climate change, global poisoning, food insecurity, population and urban failure, pandemic disease and uncontrolled new technologies (like killer robots, artificial intelligence and universal surveillance) – reinforced by a prodigious capacity for human self-delusion. But sticking our heads in the sand and trying to ignore them will not remove the danger.

These threats are known as ‘existential risks’ because they imperil our future existence, both as individuals, as a civilisation and maybe even as a species.

Their most important feature is the fact that they are not isolated from one another. They are deeply interwoven. They play into and feed one another. They cannot be addressed separately or singly, because to do so creates a situation where curbing one risk only makes other risks worse. Together they constitute a single existential emergency facing all of humanity.

An example of why they cannot be addressed piecemeal is trying to solve the global food problem by intensifying agriculture worldwide using fossil fuels, fertilisers and petrochemicals: this will only destroy the very climate, resources and ecosystem services on which agriculture, itself, depends – and is not, consequently, a viable or enduring solution. Other answers must be sought. Another example is that trying to end the Sixth Extinction of wildlife on our planet by turning half of it back to forest and grassland will not work on its own, because it would involve the sacrifice of half the current human food supply: consequently, we need a solution that achieves both aims – sustainable food for all and a sufficient haven for the Earth’s other species. So, the problem of extinction needs to be solved, in part, by solving the problem of food – and that, in turn, entails solving the problems of climate, global poisoning, resource depletion and other mega-risks. It is absolutely clear from this that the solutions we adopt must be cross-cutting. They must comprehensively address all the perils we face, not just one or a handful of them.

Take these ten great risks together and what you have is the focal issue of our time – the greatest and most profound challenge ever to confront human civilisation. The risks are all selfinflicted, a direct result of the overgrowth in human numbers and our unbridled demands on the planet – for food, resources, space and a healthy environment. By solving them together, we ensure our future. By denying them or failing to solve them all in time, we knowingly create untold misery and suffering for most of humanity and generations to come through the centuries ahead. We are gambling with the very survival of our civilisation and species. The risks are described below, along with observations about how they play into the Food or War scenario. The detail, the scientific sources and the solutions, collective and individual, to each risk are described in more detail in Surviving the 21st Century.

Extinction and Ecological Collapse

More than half of the large animals that once inhabited the Earth have been wiped from it by human action since 1970, according to the Worldwide Fund for Nature’s Living Planet Index.3 So, too, have half the fish in the sea on which humans rely for food.4 Humans are, in the words of the great biologist E. O. Wilson, ‘tearing down the biosphere’, demolishing the very home that keeps us alive.5

Extinction, it should be noted, is a part of life: 99.9 per cent of all species ever to evolve on this planet have disappeared, and new ones like ourselves have arisen to replace them. But extinction rates like today’s – a hundred to a thousand times faster than normal – are a freak occurrence that usually takes tens of millions of years, not mere decades. Animal, plant and marine species are presently vanishing so fast that scientists have dubbed our time “the Sixth Extinction” – the sixth such megadeath in the geological history of the Earth.6 By the end of the present century, Wilson says, it is possible that up to half of the eight million species thought to exist here will be gone. Furthermore, in all previous extinctions, natural events like asteroid strikes and vast volcanic outbursts have been to blame. This will be the only time in the Earth’s history when the wipe-out was caused by a single species. Us.7

The probability of humans becoming extinct during the twentyfirst century is not high – but there are scenarios, such as an all-out nuclear war, runaway climate change (+5–10 C or more), or a compound collapse in the Earth’s main life support systems, in which it must be regarded as a possibility – and the fact that it is unpleasant to contemplate is no excuse for doing nothing to stop it.

However, there are also a number of credible scenarios in which large-scale ecosystem collapse could endanger civilisation and cause very high mortality among the world’s population. These revolve around the notion of ‘environmental security’ which is, in turn, very closely tied to human security – i.e. peace or war. An ecosystem is a biological community of mutually dependent species – and the removal of one species after another can undermine it and render it dysfunctional, in the same way that pulling one brick at a time out of your home will eventually cause it to fall down. Ecosystems support all life on the planet, and maintain the quality of air, water and soil on which it depends. For humans, they provide food and clean water (provisioning services), disease and climate regulation (regulatory services), spiritual and aesthetic fulfilment (cultural services), useful chemical energy (from plants) and soil formation (support services). As ecosystems decay, the decline and loss of these services often causes significant harm to human wellbeing and can inflame the tensions that lead to conflict.

The most destructive object on the planet, as we noted in Chapter 3, is the human jawbone. The need to keep it fed is responsible, every year, for the loss of up to 75 billion tonnes of topsoil, the wasting of six trillion tonnes of water, the release of five million tonnes of pesticides, and 30 per cent of the world’s climate-wrecking carbon emissions. In addition, the contemporary food system is the chief driver of deforestation, desertification, wildlife extinctions and impaired ecosystems. Among the most striking examples of food’s impact on the wild world are the 400+ ‘dead zones’ spreading through the world’s oceans from the Arabian Sea, to the Baltic and the Mississippi delta. These are oxygenless layers in the sea, where fish cannot survive. They are caused by topsoil dislodged by land clearing, over-farming and over-grazing, the use of huge quantities of artificial fertilisers, toxic chemicals and human sewage. Along with overfishing they contribute to an ongoing collapse in world wild fisheries and are a clear example of how the activity of one part of the food system can impair another. Similarly, most inland rivers and lakes in populated regions are eutrophic and polluted – and no longer capable of producing as much food as in the past. The loss of wild fisheries increases tensions between nations and fishers over what remains and can lead to ‘fish wars’. 8

The existing global food production system is therefore a major contributor to the decline and failure of ecosystem services needed to support the human population. This in turn rebounds on the food system itself. Furthermore, the extinction of wild animals and plants deprives the food industry of many edible species that may be needed as part of a healthy, diverse global diet in future.

The solution to the extinction crisis is to cease farming and grazing on about half the currently farmed area of the planet (25 million square kilometres), transfer food production to the cities where it can take advantage of all the nutrients and water currently being wasted, and employ many of the world’s farmers and indigenous people as Stewards of the Earth to manage the rewilding and regeneration of former farmlands. Food production can continue on the remaining 24 million square kilometres using eco-agriculture. This process is further described in Surviving the 21st Century and in Chapter 9 of this book.

How the existing food system plays into the risk of war can also be viewed through the lens of environmental security: war damages environments, making it harder for humans to sustain and feed themselves – and ruined environments themselves become cauldrons of war. This is plainly to be seen in the cases of Syria, South Sudan, Yemen and the Horn of Africa. What we most need are food systems that do not cause knock-on damage to either the environment and wildlife, the climate, the oceans or to consumer health – and which ease tensions, so promoting peace, not conflict. These are described in Chapters 8 and 9.

Resource Scarcity

The average citizen of planet Earth today uses at least ten times the volume of resources used by their grandparents a century ago. Since the human population has also quadrupled over the same time, this means humanity’s gargantuan appetite for minerals, metals, timber, water, food and energy has grown fortyfold in barely a hundred years. As the Global Footprint Network explains, we are presently using enough ‘stuff’ for 1.6 Earths, not just the one we have. We now outrun the Earth’s natural ability to supply our needs in August each year.9 As with the mining of groundwater, the decline and collapse of global resources like soil, water and phosphorus, is often imperceptible to the individual: people have simply no idea they are living on borrowed time and, with that, comes enormous risk.

To make the issue of resource consumption a little more personal: you (as an average individual citizen of the planet) will in your lifetime

– use 99,720 tonnes (i.e. 40 Olympic pools) of fresh water

– displace 750 tonnes of topsoil

– consume 720 tonnes of metals and materials

– use 80 billion joules of energy

– release 288 tonnes of CO2

– release 320 kilograms of toxic chemicals

– waste 13.4 tonnes of food

– destroy 800 square metres of forest.

Because of the long, cryptic, industrial and international trade chains which hide it, most of us are unaware of the vast damage we do to the planet through our simple habit of shopping.

Yes, some of us have a notion that some of our purchases may be bad for gorillas in the Congo, orangutans in Borneo or flamingos in the Atacama – but we mostly have no true appreciation of the wider havoc we inflict on the Earth and its natural systems by the ‘innocent’ act of consumption, which business and governments try constantly to convince us is essential to ‘growth and jobs’.

It should therefore come as no surprise that the world finds itself increasingly short of key resources like fresh water, soil, phosphorus, timber and certain minerals – and that these shortages are giving rise to tensions and even to conflicts. Indeed, resource scarcity has for some time been considered by strategic experts to be one of the most likely causes of war in the twentyfirst century.10

However, people are not equally responsible for the devastation of Planet Earth. The diagram below (Figure 6.1), from [[FIGURE 6.1 OMITTED]] Oxfam, illustrates how just one tenth of humanity consumes five times as much in the way of material resources (expressed here in the form of their carbon footprint) as the poorest half of the world population. The affluent are chiefly responsible for the destruction taking place on a global scale as they seek to sustain lifestyles that the planet can no longer afford or support.

The significance of this blind spot around consumption for global food security is very great. As described in earlier chapters, the world food system depends critically on soil, water, nutrients and a stable climate, to supply humanity’s daily need for nutriment – and all of these essential resources are in increasingly short supply, chiefly because of our own mismanagement of them and our collective failure to appreciate that they are finite. On current trends, the existing food system will tend to break down, first regionally and then globally, owing to resource scarcity from the 2020s onward, and especially towards the mid century – unless there is radical change in the world diet and the means by which we feed ourselves. This will lead to increasing outbreaks of violence and war. Nobody, neither rich nor poor, will escape the consequences.

Weapons of Mass Destruction

Detonating just 50–100 out of the global arsenal of nearly 15,000 nuclear weapons would suffice to end civilisation in a nuclear winter, causing worldwide famine and economic collapse affecting even distant nations, as we saw in the previous chapter in the section dealing with South Asia. Eight nations now have the power to terminate civilisation should they desire to do so – and two have the power to extinguish the human species. According to the nuclear monitoring group Ploughshares, this arsenal is distributed as follows:

– Russia, 6600 warheads (2500 classified as ‘retired’)

– America, 6450 warheads (2550 classified as ‘retired’)

– France, 300 warheads

– China, 270 warheads

– UK, 215 warheads

– Pakistan, 130 warheads

– India, 120 warheads

– Israel, 80 warheads

– North Korea, 15–20 warheads.11

Although actual numbers of warheads have continued to fall from its peak of 70,000 weapons in the mid 1980s, scientists argue the danger of nuclear conflict in fact increased in the first two decades of the twenty-first century. This was due to the modernisation of existing stockpiles, the adoption of dangerous new technologies such as robot delivery systems, hypersonic missiles, artificial intelligence and electronic warfare, and the continuing leakage of nuclear materials and knowhow to nonnuclear nations and potential terrorist organisations.

In early 2018 the hands of the ‘Doomsday Clock’, maintained by the Bulletin of the Atomic Scientists, were re-set at two minutes to midnight, the highest risk to humanity that it has ever shown since the clock was introduced in 1953. This was due not only to the state of the world’s nuclear arsenal, but also to irresponsible language by world leaders, the growing use of social media to destabilise rival regimes, and to the rising threat of uncontrolled climate change (see below).12

In an historic moment on 17 July 2017, 122 nations voted in the UN for the first time ever in favour of a treaty banning all nuclear weapons. This called for comprehensive prohibition of “a full range of nuclear-weapon-related activities, such as undertaking to develop, test, produce, manufacture, acquire, possess or stockpile nuclear weapons or other nuclear explosive devices, as well as the use or threat of use of these weapons.”13 However, 71 other countries – including all the nuclear states – either opposed the ban, abstained or declined to vote. The Treaty vote was nonetheless interpreted by some as a promising first step towards abolishing the nuclear nightmare that hangs over the entire human species.

In contrast, 192 countries had signed up to the Chemical Weapons Convention to ban the use of chemical weapons, and 180 to the Biological Weapons Convention. As of 2018, 96 per cent of previous world stocks of chemical weapons had been destroyed – but their continued use in the Syrian conflict and in alleged assassination attempts by Russia indicated the world remains at risk.14

As things stand, the only entities that can afford to own nuclear weapons are nations – and if humanity is to be wiped out, it will most likely be as a result of an atomic conflict between nations. It follows from this that, if the world is to be made safe from such a fate it will need to get rid of nations as a structure of human self-organisation and replace them with wiser, less aggressive forms of self-governance. After all, the nation state really only began in the early nineteenth century and is by no means a permanent feature of self-governance, any more than monarchies, feudal systems or priest states. Although many people still tend to assume it is. Between them, nations have butchered more than 200 million people in the past 150 years and it is increasingly clear the world would be a far safer, more peaceable place without either nations or nationalism. The question is what to replace them with.

Although there may at first glance appear to be no close linkage between weapons of mass destruction and food, in the twentyfirst century with world resources of food, land and water under growing stress, nothing can be ruled out. Indeed, chemical weapons have frequently been deployed in the Syrian civil war, which had drought, agricultural failure and hunger among its early drivers. And nuclear conflict remains a distinct possibility in South Asia and the Middle East, especially, as these regions are already stressed in terms of food, land and water, and their nuclear firepower or access to nuclear materials is multiplying.

It remains an open question whether panicking regimes in Russia, the USA or even France would be ruthless enough to deploy atomic weapons in an attempt to quell invasion by tens of millions of desperate refugees, fleeing famine and climate chaos in their own homelands – but the possibility ought not to be ignored.

That nuclear war is at least a possible outcome of food and climate crises was first flagged in the report The Age of Consequences by Kurt Campbell and the US-based Centre for Strategic and International Studies, which stated ‘it is clear that even nuclear war cannot be excluded as a political consequence of global warming’. 15 Food insecurity is therefore a driver in the preconditions for the use of nuclear weapons, whether limited or unlimited.

A global famine is a likely outcome of limited use of nuclear weapons by any country or countries – and would be unavoidable in the event of an unlimited nuclear war between America and Russia, making it unwinnable for either. And that, as the mute hands of the ‘Doomsday Clock’ so eloquently admonish, is also the most likely scenario for the premature termination of the human species.

Such a grim scenario can be alleviated by two measures: the voluntary banning by the whole of humanity of nuclear weapons, their technology, materials and stocks – and by a global effort to secure food against future insecurity by diverting the funds now wasted on nuclear armaments into building the sustainable food and water systems of the future (see Chapters 8 and 9).

Climate Change

The effects of food and war on climate change as it is presently predicted to occur were described in Chapter 3: in brief, the stable climate in which agriculture arose over the past 6000 years is now becoming increasingly unstable as a result of the billions of tonnes of carbon that humans are injecting into the atmosphere and oceans, forming a colossal heat engine to drive more frequent, violent weather. This in turn impairs food production in regions of the world already facing severe stresses from population growth and resource depletion. Military analysts describe climate change as a ‘threat multiplier’, augmenting the tensions, conflict and instability which already exist. In reality it is a feedback loop, in which worsening climate conditions cause greater food insecurity, which is met by measures (like increased land clearing and use of fossil fuels and chemicals), which in turn worsen climate conditions, which worsen food security, which cause wars, which inflict more eco-damage...

Two degrees (2 C) of global warming – described as the danger point for humanity – are predicted to occur well before 2050 because of our collective failure to curb our carbon emissions.16 Those 2 C of warming portend bad things for any food system that depends on the weather – but just how bad cannot easily be forecast as both the climate state and the response of the global food system are governed by human behaviour, which is fairly unpredictable. Current estimates suggest crop losses of the order of 20–50 per cent at the very time we are trying to raise food output by 50–70 per cent. What can be confidently predicted, however, is that there will be an increase in both the frequency and scale of harvest failures and agricultural disease outbreaks around the world as we approach the mid century – and that beyond 2 C of warming it will become very hard indeed to maintain a stable outdoors, agriculture-based system to meet an anticipated doubling in world demand for food by the 2060s. The ‘worst case’ risk of this, as previously outlined, would be ten billion people having to subsist on enough food to feed only four billion.

That, however, is by no means the worst case of the climate story. There are ominous signs that humans have already unleashed planetary forces over which we have absolutely no control – and that these, should they become large enough, will take charge of the Earth’s climate engine and drive it into a superheated condition of +9–10 C or even higher.

Today, more people are aware that global warming may lead to complete melting of all glaciers and the polar ice-caps, thereby raising sea levels by 65 metres and inundating almost all of the world’s seaboard cities, fertile river deltas and coastal plains.17 This would clearly have a devastating effect on coastal food production. However, this process will probably take several centuries, allowing populations ample time to relocate inland. That sea levels previously rose by a similar quantum at the end of the last Ice Age, flooding part of Australia, severing Britain from Europe and America from Asia, is proof enough that such events occur as a regular part of the Earth’s warming and chilling cycles.

The great existential threat to humanity lies in vast stores of frozen methane gas (CH4) locked into the soils of the tundra regions of Canada and Siberia, in colossal deposits of frozen methane on the continental seabed surrounding the Arctic Ocean, and in massive stores of methane submerged in peat deposits and swamps in places such as the Amazon and the wet tropical forests of Southeast Asia and Africa. Methane is a gas with 20–70 times the climate-forcing power of carbon dioxide. These deposits are the accumulation of the slow decomposition of planet and animal matter in the Earth’s sediments over several hundred million years – they are identical in origin to the gas bubbles that surface when we stir the bed of a pond or lake.

The actual volume of these methane deposits is still being assessed by science. Recent estimates suggest:

• seabed deposits – between 500–2500 billion tonnes of frozen carbon;18

• tundra deposits – potentially emitting 180–420 million tonnes of carbon a year by 2100; and

• tropical peat swamps – could emit 480–870 million tonnes of carbon a year by 2100.19

That carbon released from peat swamps, tundra and possibly the oceans can have a catastrophic effect on the Earth’s climate is foreshadowed by an event known as the Palaeocene–Eocene Thermal Maximum (PETM), which took place some 55 million years ago, when Earth took a sudden fever and its temperature rocketed upwards by +5–9 C. This ‘heat spike’ caused a lesser extinction event involving widespread loss of ocean life and a smaller toll of land animals.20 However, the heating occurred over a much longer period – 100–200,000 years, compared with human-driven heating (50–100 years) – and is thought to have been mainly caused by the drying out and burning of tropical peat swamps as the climate warmed. However, the volume of carbon which caused this sharp planetary heat spike in the past is estimated to be barely a tenth of that released by humanity today.21

Today, human activity in clearing rainforests, draining swamps and burning the world’s forests to open them up for farming and food production is releasing vast amounts of methane and CO2. Explosion craters have been reported across Canada and Siberia as frozen methane deposits well up and erupt with the melting of the tundra. And scientists from Sweden, Russia, Canada and America have reported methane bubbling from the seabed of the Arctic Ocean, though not yet in massive volumes. The risk in all this is that, by warming the planet by only 1–2 C, we have set in train natural processes that we are powerless to control, setting ourselves on an inescapable trajectory to a Hothouse Earth, 5–10 C or more above today’s levels.

Although it is hard to estimate, some scientists are of the view that fewer than one billion humans would survive such an event22 – in other words, nine people out of every ten may perish in the cycle of famines, wars, heatwaves and pandemic diseases which global overheating would entail. This underlies the deadly urgency of ceasing to burn all fossil fuels, locking up as much carbon as possible and re-stabilising the Earth’s climate. In that, food production can and will play a central role.

Poisoned Planet

‘Earth, and all life on it, are being saturated with man-made chemicals in an event unlike anything which has occurred in all four billion years of our planet’s story. Each moment of our lives, from conception unto death, we are exposed to thousands of substances, some deadly in even tiny doses and most of them unknown in their effects on our health and wellbeing or upon the natural world. These enter our bodies with every breath, each meal or drink, the clothes we wear, the products with which we adorn ourselves, our homes, workplaces, cars and furniture, the things we encounter every day. There is no escaping them. Ours is a poisoned planet, its whole system infused with the substances humans deliberately or inadvertently produce in the course of extracting, making, using, burning or discarding the many marvellous products on which modern life depends. This explosion in chemical use and release has all happened so rapidly that most people are blissfully unaware of its true magnitude and extent, or of the dangers it now poses to us all as well as to future generations for centuries to come.’

This is a summation of the chemical crisis facing all of humanity, as well as all life on Earth, which I wrote in Surviving the 21st Century, and which is based on the extensive scientific research reported in Poisoned Planet.23 It is a crisis with profound impact for everyone.

According to the medical journal The Lancet, nine million people – one in six – die every year from chemical pollution of their air, water, food and living environment.24 A further 40 million die from the so-called noncommunicable or ‘lifestyle’ diseases (NCDs), cancer, heart disease, diabetes and lung disease, which are mostly diet-related.25

Food production, as we have seen, is deeply implicated in the chemical deluge. However, it is also an existential threat to human health, both in terms of infectious disease and the new ‘lifestyle’ diseases. No-one to my knowledge has compiled an accurate assessment of the total chemical effusion of humanity or presented a realistic impression of its true scale. Box 6.1 represents my own best estimate, drawn from various reliable sources.

From this it can easily be seen that the scale of humanity’s chemical assault on ourselves and on the planet is many times the scale of our climate assault – yet this issue commands nowhere near the political or scientific priority that it should. It is arguably the most under-rated, under-investigated and poorly understood of all the existential threats to humanity.

The poisoning of the Earth by human activities has grave implications for the health and safety of the global food chain and its eight billion consumers. It is not only the use of chemicals in food production that is of concern, but also the contamination of water, soils and livestock by industrial pollutants from other sources, such as mining or manufacturing. It is also the disruption of vital services such as pollination by insects of a [[BOX 6.1 OMITTED]] third of the world’s food crops and 90 per cent of wild plants.26 It is the contamination of up to three quarters of the world fish catch with microscopic plastic particles and clothing microfibres made by the petrochemical industry.27

The ending of this flood of poisons is a prerequisite for a safe, healthy and sustainable global food supply in future. And, since government regulation has largely failed to stem the worldwide flood, the task now falls to consumers – to choose foods which have been produced by safe methods and shun foods produced by unsafe methods. That is the only way that the food industry can be encouraged (and penalised) into doing the right thing by humanity and the planet: by consumers rewarding it for producing clean food and punishing it for toxic food. Otherwise it will continue to pollute as profitably as it can. It follows that the urgent global education of consumers about which foods are safe and which are toxic is also a pre-requisite.

Food Security

Our demand for food is set to double by the 2060s – potentially the decade of ‘peak people’, the moment in history when the irresistible human population surge may top out at around 10 billion. However, as we have seen, many of the resources needed to supply it agriculturally could halve and the climate for the growing of food outdoors become far more hostile.

Why food insecurity is an existential threat to humanity should, by now, be abundantly clear from the earlier chapters of this book: present systems are unsustainable and, as they fail, will pose risks both to civilization and, should these spiral into nuclear conflict, to the future of the human species.

The important thing to note in this chapter is that food insecurity plays into many, if not all, of the other existential threats facing humanity. The food sector’s role in extinction, resource scarcity, global toxicity and potential nuclear war has already been explained. Its role in the suppression of conflict is discussed in the next chapter. Its role in securing the future of the megacities, and of a largely urbanised humanity, is covered in Chapter 8. And its role in sustaining humanity through the peak in population and into a sustainable world beyond is covered in Chapter 9.

Food clearly has a pivotal role in the future of human population – both as a driver of population growth when supplies are abundant and as a potential driver of population decline, should food chains collapse. It is no exaggeration to state that the fate of civilisation depends on it.

Pandemic Disease

Disease pandemics have been a well-known existential risk to humanity since the plague of Athens in 430 BC – itself linked to a war. However, a point that escapes many people nowadays is that, as humans have become so numerous – indeed the predominant lifeform on the planet – we have also become the major food source for many microbes. We are now the ‘living compost heap’ on which they must dine and in which they must reproduce, if they are themselves to survive.

As our own population grows, pandemics are thus likely to increase, as more and more viruses and bacteria are forced to take refuge in humans following the depletion or total extinction of their natural hosts, the wild animals we are exterminating. This process is greatly assisted by our creation of megacities, tourism and air travel, schools and child-minding centres, air-conditioned offices, night clubs, sex with strangers, pet and pest animals, insects which prosper from climate change or human modification of the environment (like mosquitoes), ignorance, poor public hygiene, lack of clean water, and deficient food processing and handling.

So, while humanity is confronted with an ever-expanding array of parasites, we are simultaneously doing everything in our power to distribute them worldwide in record time – and to seed new pandemics. The World Health Organisation has identified 19 major infectious diseases with potential to become pandemic: chikungunya, cholera, Crimean-Congo haemorrhagic fever, Ebola, Hendra, influenza, Lassa fever, Marburg virus, meningitis, MERS-CoV, monkeypox, Nipah, plague, Rift Valley fever, SARS, smallpox, tularaemia, yellow fever and Zika virus disease.28 While none of these is likely to fulfil the Hollywood horror movie image of wiping out the human species – for the simple reason that viruses are usually smart enough to weaken to a sublethal state once comfortably ensconced in their new host – the apocalyptic horseman representing Pestilence and Death will nevertheless continue to play a synergetic role with his companions warfare, famine, climate change, global poisoning, ecological collapse, urbanisation and other existential threats.

Food insecurity affects the progression of pandemic diseases, often in ways that are not entirely obvious. First, new pandemics of infectious disease tend to originate in developing regions where nutritional levels are poor or agricultural practices favour the evolution of novel pathogens such as, for example, the new flu strains seen every year – which arise mainly from places where people, pigs and poultry live side-by-side and shuffle viruses between them – and also novel diseases like SARS and MERS. Second, because totally unknown diseases tend to arise first in places where rainforests are being cut down for farming and viruses hitherto confined to wild animals and birds make an enforced transition into humans. Examples of novel human diseases escaping from the rainforest and tropical savannah in recent times include HIV/AIDS, Hendra, Nipah, Ebola, Marburg, Lassa and Hanta, Lujo, Junin, Machupo, Rift Valley, Congo and Zika.29 And thirdly, because the loss of vital micronutrients from heavily farmed soils and from food itself predisposes many populations to various deficiency diseases – for example, a lack of selenium in the diet has been linked with increased risk from both HIV/AIDS and bowel cancer.30 A key synergy is the way hunger and malnourishment exacerbate the spread of disease, classic examples being the 1918 Global Flu Pandemic which spread rapidly among war-starved populations, or the more recent cholera outbreak in war-torn Yemen. In a fresh twist, Dr Melinda Beck of North Carolina University has demonstrated that obesity – itself a form of malnutrition – may cause increased deaths from influenza by both aiding the virus and suppressing the patient’s immune response.31

#### Pandemics will cause extinction.

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Abstract

The recent SARS-CoV-2 pandemic, which is causing COVID-19 disease, has taught us unexpected lessons about the dangers of human suffering through highly contagious and lethal diseases. As the COVID-19 pandemic is now being partially controlled by various isolation measures, therapeutics, and vaccines, it became clear that our current lifestyle and societal functions may not be sustainable in the long term. We now have to start thinking and planning on how to face the next dangerous pandemic, not just overcoming the one that is upon us now. Is there any evidence that even worse pandemics could strike us in the near future and threaten the existence of the human race? The answer is unequivocally yes. It is not necessary to get infected by viruses found in bats, pangolins, and other exotic animals that live in remote forests to be in danger. Creditable scientific evidence indicates that the human gut microbiota harbor billions of viruses that are capable of affecting the function of vital human organs such as the immune system, lung, brain, liver, kidney, or heart. It is remotely possible that the development of pathogenic variants in the gut can lead to contagious viruses, which can cause pandemics, leading to the destruction of vital organs, causing death or various debilitating diseases such as blindness, respiratory, liver, heart, and kidney failures. These diseases could result in the complete shutdown of our civilization and probably the gradual extinction of the human race. This essay will comment on a few independent pieces of scientific facts, and then combine this information to come up with some (but certainly not all) hypothetical scenarios that could cause human race misery, even extinction, in the hope that these hypothetical scenarios will trigger preventative measures that could reverse or delay the projected adverse outcomes.

Keywords: pandemics; contagious diseases; human race extinction; viruses; microbiome; COVID-19; blindness

1 Introduction

Le Chatelier’s Principle: Named after the French chemist, Le Chatelier’s principle posits that “When an external stress (change in pressure, temperature or concentration) is applied to a system in chemical equilibrium, the equilibrium will change in such a way as to reduce the effect of the stress.” In other words, a change in a system will evoke a counter-change, which will bring the equilibrium to a new point. This principle operates with almost every human or other activity. For example, it is known that when fruit production in the Serengeti ecosystem is reduced, the number of elephants, which feed on these fruits, is reduced proportionally. In the context of this essay, I hypothesize that human-made changes in climate, the atmosphere, water, soil, and all other planet-living organisms, will likely evoke counter-changes that may be highly consequential to human life. Due to the complexity of our ecosystem, humans do not know exactly how these changes will affect them in the end. Consequently, they choose to disregard them because lifestyle adjustments may cost money and convenience or loss of well-established pleasures.

1.1 The earth is changing rapidly

What is changing on the earth that could induce a potentially catastrophic counter-change? The answer is everything is changing[1], from the living inhabitants (humans, other species, and plants) to the atmosphere, water, soil, climate, among else.

The changes caused by human activity are sometimes dramatic. For example, it has been estimated that about 1 million out of 8.5 million species of plants, animals, and other organisms are in imminent danger of extinction [1]. Other estimates show that 50% of the organisms that existed 50 years ago have already gone extinct, not to consider additional species that are gone before we even identify them. Soon, we will likely be losing more than 80% of the world’s species due to human overdevelopment and its associated consequences. The major reasons for species extinction are habitat destruction, pesticide poisoning, and illegal hunting [1].

2 Global warming

Some may choose to believe what the politicians are debating about: that climate change is a fact or fiction, but the data say that the last 6 years were the warmest on record [2]. Overall, the planet was 1.25°C warmer than in preindustrial times (in the 1950s). Warmer oceans are melting ice sheets and rising sea levels by almost 5 mm per year. In Australia, record-setting heat and drought were responsible for the bushfires that destroyed almost 25% of southeastern Australia’s forests and their living inhabitants, such as koalas. If we cannot slow down earth’s heating by reducing emissions, the current increase of about 0.2°C per decade will likely be rapidly surpassed. How will the planet react? Likely with more catastrophic fires, tsunamis, earthquakes, and floods. The human homeostatic changes to increased temperatures are very complex and include many vital organs [3]. Global warming may also cause changes in the biology of our candidate foes, the viruses, bacteria, and parasites that live in our gut and skin (see Section 2.2).

2.1 How much human-made environmental damage has been done already?

Humans are now the undisputed masters of the planet and cannot be easily stopped from actively destroying it, consciously or unconsciously. An interesting question is how much damage has been claimed to be done already, and do we have the data to support these claims? Elhacham et al. have recently compared the natural biomass that exists on the earth with the human-made (anthropogenic) mass [4]. They found that each person on the globe produces a mass that is about equal to their body weight every week! Is that too little or too much? Let us first define biomass and anthropogenic mass. The majority of the earth’s biomass is represented by trees and bushes. The majority of the man-made mass is represented by buildings and infrastructure such as roads and consists of concrete, bricks, asphalt, metals, and plastic. Just consider that the total global mass of produced plastic so far is greater than the overall mass of all terrestrial and marine animals combined!

So, how do we fare when comparing biomass to anthropogenic mass production? In the 1900s, the latter represented only 3% of global biomass; but now, in the 2020s, the two masses are about equal. The projection is that if we go on with more deforestation, buildings, streets, plastics, cars, and so on, by 2040, it is likely that anthropogenic mass will almost triple the earth’s biomass. Will there be enough resources and clean air and water to sustain the life of the projected 9 billion inhabitants? Anthropogenic mass production is difficult to slow down since this activity is considered part of our evolving civilization and way of living.

2.2 Human microbiome

The human body consists of approximately 30 trillion cells, but the microbiota population in the human gut is estimated to be 300 trillion [5]! In addition, there is another microbiota in the skin and other organs. It was initially thought that these microbiota act locally (e.g., only in the gut or skin), but new evidence suggest that the effects of microbiota may be global, reaching every cell in the body. This can be achieved with various mechanisms, one being the transmission of signals mediated by proteins that can travel through anatomically distinct structures such as the vagus nerve. For example, a protein called curli can travel through the vagus nerve and reach the brain, where it can promote abnormal aggregation of proteins such as a-synuclein, one major pathogenetic player in Parkinson’s disease [5,6]. Another and even more likely mechanism includes the diffusion of bacterial or viral proteins (some could be toxins to various organs) or pathogenic viruses into the bloodstream. From there, they can travel around the body. This is reminiscent of cancer cell metastasis by the hematogenous route. One piece of evidence for that happening is that about half of the human metabolome (the collection of all metabolites in the blood) is derived by host bacteria [5]. Bacteria or virus-derived metabolites could also pass through the placenta and reach the fetus, including the fetal brain, possibly causing diseases such as autism.

Despite skin not being as hospitable to microorganisms as the gut, a typical person may have about 1,000 species of bacteria on their skin [7]. These microbial communities continue to grow and diversify until puberty when hormonal and developmental changes reach a plateau. The balance between host and bacteria in the skin is determined by the production of skin-derived microbial nutrients, microbiome-derived skin nutrients, skin, and microbiome-derived antimicrobial peptides, and by the interaction of the microbiome with the host’s immune system. Similar as in the gut, there is a delicate balance between beneficial and potentially harmful bacteria and the host immune system. It is remotely possible that our future enemies may derive from the gut, skin, or other organs harboring microorganisms. In addition, the skin is more sensitive to environmental changes such as climate change as it is directly exposed to the environment.

In conclusion, bacterial, viral, and parasite-derived proteins or pathogenic viruses thrive locally (e.g., in the gut or skin) but are capable of acting globally.

2.3 Human viruses and how they could cause disease

Many strains of gut bacteria are harmless, but they can become dangerous pathogens under certain conditions, such as antibiotic use [8]. It is well known that gut bacteria can harbor many viruses (bacterial phages) [9]. If they do not immediately kill the infected bacteria, these viruses incorporate into the bacterial genome and stay latent for extended periods (they are known “prophages”). These prophages can be reactivated under certain environmental or other factors and act like pathogenic viruses. It is rather surprising that, in general, viruses are so many that they qualify as the most abundant biological entities on the planet. Sometimes, gut bacteria use their activated prophages as weapons to gain an advantage and kill other competing bacteria. Phages could also assist in bacterial evolution as the latter become more virulent [10]. The gut bacteria also seem to interact with the host immune system and can influence the efficacy of cancer immunotherapy [11,12,13]. The microbiome has been blamed for playing direct or indirect roles in many human diseases, including cancer, metabolic syndrome, diabetes, dementia, and others [14].

The outcomes regarding health and disease depend on the balance of powers among the gut/skin/other organ viruses, the gut/skin/other organ microbiomes, and the host immune system. If this balance is disturbed, a biological war between these players will be initiated, and the outcome will be unpredictable.

In conclusion, scientific evidence supports the idea that phages in the mammalian intestine, skin, or elsewhere, not only can be engulfed by certain eukaryotic cells but also might escape from the gut or skin, enter the bloodstream, and make their way into other parts of the body, with as yet undiscovered consequences.

2.4 Viral variants

Viruses evolve continuously, eventually leading to more transmissible variants, which sometimes can be more lethal than the original strains. The SARS-CoV-2 is an excellent contemporary example. Multiple variants of SARS-CoV-2 are rapidly spreading and are becoming dominant in certain geographic areas [15,16]. For example, the B.1.1.7 variant (United Kingdom) has 23 mutations and 17 amino acid changes; variant 501Y.V2 (South Africa) has 23 mutations and 17 amino acid changes; and P.1 variant (Brazil) has approximately 35 mutations with 17 amino acid changes.

In April 2021, when this document was first written, I speculated verbatim that “new variants with additional mutations could become able to evade our currently available vaccines by weakening the ability of vaccine-induced antibodies to neutralize/block viral entry, and by strengthening the ability of the virus to enter the cells via surface receptors.” The so-called “omicron variant,” isolated in November 2021, already fulfilled this prediction.

2.5 How COVID-19 and possibly other viruses affect the brain

In general, viral invasion of the central nervous system may be achieved by several routes, including transsynaptic transfer across infected neurons, entry via the olfactory nerve, infection of vascular endothelium, or leukocyte migration across the blood–brain barrier. SARS-CoV-2 invades endothelial cells via transmembrane angiotensin-converting enzyme 2 (ACE2) receptor binding and a subsequent proteolytic event, facilitated by transmembrane protease serine 2 [17]. Is there evidence that SARS-CoV-2 can enter the brain? The answer is yes [18]. As already mentioned, one route is by migrating from the cribriform plate along the olfactory tract [19] or through vagal pathways. Another route may include viral entry into brain capillary endothelial cells via the ACE2 pathway. Viral RNA was detected in the medulla and cerebellum by reverse transcription-polymerase chain reaction. However, viral proteins seem to be absent from neurons and glial cells. Consequently, the adverse events of the virus on the brain, including altered neurotransmission and neuronal damage, are likely mediated by neuroinflammation and hypoxic injury through cytokines and other proinflammatory mediators.

2.6 SARS-CoV-2 and possibly other viruses can affect the senses

Viruses can affect our senses. For example, SARS-CoV-2 causes anosmia (loss of smell) and ageusia (loss of taste) in 40–70% of COVID-19 patients [20]. These effects persist, but it is unknown for how long. Other neurological symptoms include headache, stroke, impairment of consciousness, seizure, anxiety, and encephalopathy.

Current evidence suggests that SARS-CoV-2-related anosmia may be a new viral syndrome specific to COVID-19. This syndrome is likely mediated by intranasal inoculation of SARS-CoV-2 into the olfactory neural circuitry. Since the olfactory sensory neurons do not express ACE2 receptor, the likely explanation for the loss of smell is the damage of accessory cells supporting these neurons.

Although anosmia is not a lethal or severe disease, other neurological damage such as blindness could be devastating [21,22].

3 Adverse scenarios

Fifty years ago, one adverse scenario regarding a pandemic was presented in the film “The Andromeda strain,” which describes a pandemic caused by a pathogen of extraterrestrial origin [23]. Here, I present an alternative hypothetical scenario that involves an endogenous virus. Obviously, there is a myriad of similar scenarios, and the one given below can be currently classified as fictional but not impossible.

A prophage, which was residing dormant for years in the genome of the commensal gut bacterium Bifidobacterium infantis suddenly, and without an apparent reason, has undergone induction and started to produce viral proteins, which were subsequently assembled into whole phages. After cell lysis, these phages infected other neighboring cells. This cycle was repeated many times, and millions of free virions were released, some entering the systemic circulation (viremia). Some virions reached the lung endothelium and entered the endothelial cells through an, as yet, unknown receptor and started replicating and lysing these cells. The resulting mucous caused the host to cough, thus facilitating the transfer of the virus to other humans through aerosol droplets. Soon, the virus was able to infect, first a few hundred, then thousands, then millions of other unsuspected people through coughing and sneezing. The virus was able to travel all over the world as the pulmonary manifestations were mild, and most infected individuals thought it was a common flu or a similar ailment.

Scientists isolated the virus that caused this flu-like disease and determined from its genomic sequence that it was a novel member of influenza virus B, which usually causes seasonal flu. Despite the pandemic nature of the infection, nobody died, and governmental bodies were not highly concerned.

Six months later, one individual reported a weakening of his vision, which, within 3 months, progressed to total blindness. This unusual form of blindness quickly spread to other people until scientists performed epidemiological studies, which linked the blindness to the previously mentioned mild flu. Soon afterward, scientists isolated and identified the virus from the brains of blind and subsequently succumbed individuals and confirmed that the sequence matched the virus that caused the unusual flu. More elaborate studies had shown that there was unusual and very severe neuroinflammation around the occipital lobe of the brain (Brodmann area 17), an area responsible for the interpretation of visual signals arriving from the optic nerve. Several therapeutics were tried, but none was proven to be effective. Twelve months into the pandemic, 10 million people lost their vision, and within 18 months, without any success in developing therapies or a vaccine, the blindness had spread to whole nations.

3.1 Blindness

The selection of blindness as a chronic consequence of an acute pandemic was deliberate. In 1995, Portuguese author Jose Saramago published a fictional novel entitled “Blindness” (ISBN: 9780151002511), which contributed to him winning the Nobel Prize in literature in 1998.

Blindness, as portrayed in the book, is a highly detailed story of a mysterious mass epidemic that caused blindness of a whole nation and the social breakdown that followed. The blindness pandemic, in many respects, is reminiscent of the current COVID-19 pandemic. Blindness caused widespread panic, anarchy, and government lockdowns. The life of the blind people was characterized by filthiness, aggressive manners, disrespect of others, and a struggle to survive by any possible means. The breakdown of society was near total. Law and order, social services, government, schools could no longer function. Families have been separated and could not find one another. People squat in abandoned buildings and scrounge for food. Violence, disease, and despair threaten to overwhelm human coping. One of Saramago’s quotes, describing life after blindness, is reproduced here

“Perhaps humanity will manage to live without eyes, but then it will cease to be humanity, the result is obvious…”

3.2 Other ailments

Acute pandemics could cause many other chronic diseases that can threaten the sustainability of our present society. Although COVID-19 causes loss of smell and taste, these are considered nonlife-threatening ailments. However, in the long run, the permanent absence of smell and taste will mean the loss of innumerable current pleasures associated with the consumption of food and drinks. Clearly, loss of hearing will not be compatible with current societal functions or human achievements. Acute viral diseases are also associated with innumerable organ-specific diseases such as heart, kidney, and reproductive failures and disturbance of other vital functions that can paralyze our current society, economy, and culture. Even a minor weakening of our memory (mild cognitive impairment) could result in chaotic situations that authors of fiction, such as Saramago, attempt to describe in detail in future books.

3.3 Epilog

Humans have learned to take for granted what they currently have and enjoy. Perhaps, we did not realize that the human race’s spectacular advances are dependent on several potentially volatile abilities (senses, brain function) and that even one loss, or diminution of such abilities, could be detrimental, causing a collapse of our civilization. The COVID-19 pandemic helped us realize that we may be sitting on a time bomb, which might explode if we continue disturbing the current equilibrium between humans and other planetary partners. In addition to viruses of a rather exotic origin, such as SARS-CoV-2, billions of other viruses and other infectious agents in our gut, skin, and elsewhere are waiting for the right time to attack us. The lessons learned from COVID-19 should be a wake-up call for humans to stop disturbing the equilibrium with actions that favor the well-being of humans but put in danger the existence of other inhabitants of planet earth. Human migration, also known as “travel,” has facilitated the travel of our foes, along with us, in every conceivable corner of the world.

### Impact---Nuke War = Ozone Destroyed = Extinction

#### Ozone – defense before 2021 doesn’t take it into account.

Bardeen et al 21 [Charles G. Bardeen1 , Douglas E. Kinnison1 , Owen B. Toon2 , Michael J. Mills1 , Francis Vitt1 , Lili Xia3 , Jonas Jägermeyr4,5,6 , Nicole S. Lovenduski7 , Kim J. N. Scherrer8 , Margot Clyne2 , and Alan Robock3 1 National Center for Atmospheric Research, Boulder, CO, USA, 2 Department of Atmospheric and Ocean Sciences, Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO, USA, 3 Department of Environmental Sciences, Rutgers University, New Brunswick, NJ, USA, 4 NASA Goddard Institute for Space Studies, New York, NY, USA, 5 Center for Climate Systems Research, Columbia University, New York, NY, USA, 6 Potsdam Institute for Climate Impact Research (PIK), Potsdam, Germany, 7 Department of Atmospheric and Oceanic Sciences, Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO, USA, 8 Institut de Ciència i Tecnologia Ambientals (ICTA), Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain “Extreme Ozone Loss Following Nuclear War Results in Enhanced Surface Ultraviolet Radiation” <http://climate.envsci.rutgers.edu/pdf/BardeenOzoneUV2021JD035079.pdf> DOA: 8/15/2022 //ArchanSen]

For the first time, we use a modern climate model with interactive chemistry including the effects of aerosols on photolysis rates to simulate the consequences of regional and global scale nuclear wars (injecting 5 and 150 Tg of soot respectively) for the ozone layer and surface ultraviolet (UV) light. For a global nuclear war, heating in the stratosphere, reduced photolysis, and an increase in catalytic loss from the HOx cycle cause a 15 year-long reduction in the ozone column, with a peak loss of 75% globally and 65% in the tropics. This is larger than predictions from the 1980s, which assumed large injections of nitrogen oxides (NOx ), but did not include the effects of smoke. NOx from the fireball and the fires provide a small (5%) increase to the global average ozone loss for the first few years. Initially, soot would shield the surface from UV-B, but UV Index values would become extreme: greater than 35 in the tropics for 4 years, and greater than 45 during the summer in the southern polar regions for 3 years. For a regional war, global column ozone would be reduced by 25% with recovery taking 12 years. This is similar to previous simulations, but with a faster recovery time due to a shorter lifetime for soot in our simulations. In-line photolysis provides process specific action spectra enabling future integration with biogeochemistry models and allows output that quantifies the potential health impacts from changes in surface UV for this and other larger aerosol injections.

#### Extinction.

Browne 20 “Scientists warn erosion of ozone layer could lead to a modern mass extinction event” EDWARD BROWNE May 28, 2020 <https://www.express.co.uk/news/science/1287983/ozone-layer-global-warming-mass-extinction-dinosaurs-Southampton> SM

Scientists warn erosion of ozone layer could lead to a modern mass extinction event

AN unexplained mass extinction event that occurred 359 million years ago may have been caused by erosion of the ozone layer, a UK study has found.

It could have alarming implications for the way our current world is headed, regarding rising global temperatures. Researchers from the University of Southampton have been investigating an extinction event that occurred at the end of the Devonian geological period.

During their study, they found evidence that plant spores from around the time had been damaged by UV radiation, suggesting that the Earth’s ozone layer was not providing sufficient protection from the sun’s deadly rays.

While it is already known that ozone depletion could lead to an extinction event, the scientists were alarmed by the reason behind why the ozone depletion seemed to have occurred.

The researchers discovered that this particular ozone erasure could have been linked to global warming, which the scientists described as a “new mechanism for mass extinctions.”

Mass extinction events have occurred a number of times in Earth’s past, with known causes being asteroid impacts and large-scale volcanic eruptions, Phys.org reports.

Many will associate the asteroid impact event as the one that led to the extinction of the dinosaurs.

The extinction event that the Southampton scientists were studying came after a period of rapid global warming after an ice age, Phys.org continues.

As part of their study, the researchers collected rocks from sites in Greenland as well as Bolivia in order to study any clues about what Earth conditions may have been like way back 360 million years ago.

Indeed, these rocks held some clues as to what had been happening around the time of the Devonian period.

The researchers found that the rocks contained plant spores – which plants use to reproduce – that had been preserved within them for hundreds of millions of years.

They discovered that some of these spores appeared to have been damaged by something, noting that they had “malformed sculpture and pigmented walls”.

This sort of damage is similar to what would occur if the spores had been hit by high levels of ultraviolet light – also called UV rays – that are given off by the sun.

The researchers explained: “This indicates the temporary loss of the global protective ozone layer.”

This is because the ozone layer absorbs some of the UV light – a particular type called UBV – that travels from the sun to the Earth.

The US Environmental Protection Agency (EPA) notes that UVB light has been linked to skin cancer and can cause harm to crops and marine life.

The ozone layer is a part of Earth’s atmosphere located in the stratosphere between 9 and 18 miles up.

Professor Marshall, lead researcher for the team, said that “current estimates suggest we will reach similar global temperatures to those of 360 million years ago,” according to phys.org.

He added that this raises the possibility of another collapse in the ozone layer, which could have disastrous consequences for all life on Earth, including us.

In the study’s abstract, the team said: “ozone loss during rapid warming is an inherent Earth system process with the unavoidable conclusion that we should be alert for such an eventuality in the future warming world.”

As well as global warming, human activity is associated with the depletion of the Earth’s vital ozone layer.

Scientists have reported that a large ozone hole over the Antarctic is slowly beginning to recover amid international efforts to limit the amount of ozone-depleting substances belched out by mankind.

### Impact---Nuke War = Tornadoes = Extinction

#### Nuclear Tornados – creates anti-gravity columns that throw out the atmosphere – we cite the best physics and best models.

Sarg, PhD in Physics, 08 [Prepared by International Group of Scientists and Engineers, Editor-in-chief Dr. Stoyan Sarg, PhD in Physics, 2008, “MANIFESTO: Prevent Nuclear Disaster – Doomsday” <https://www.helical-structures.org/Publications/Prevent-Nuclear-Disaster-Doomsday.pdf> DOA: 01-26-2023 //ArchanSen]

In December 2007, a NATO sponsored report entitled “Towards a Grand Strategy for an Uncertain World: Renewing Transatlantic Partnership" called for a first strike preemptive use of nuclear weapons. The NATO doctrine in this report is virtually a copy of America's post 9/11 nuclear weapons doctrine as initially outlined in the 2002 Nuclear Posture Review (NPR). In the emerging new cold war, it is becoming clear that Russia will also adopt such a doctrine. When the opposing nuclear powers embrace the doctrine of a preemptive nuclear strike, it is obvious that any international diplomacy will be excluded at decisive moments. The main advantage of this doctrine is the suddenness of any attack. The preemptive nuclear strike could be triggered during a local military conflict in which the opposing powers share strategic interests. This may happen in Georgia, in the Black Sea, or during the military exercises of Venezuela and Russia in the Caribbean.

We are very concerned about the potentially disastrous consequences of a preemptive nuclear strike. The disaster would affect the entire population of the earth. It would not be merely a nuclear winter. Something much more catastrophic and irreversible may happen – a Doomsday created by humankind. This Doomsday would not be a result of the known effects of a nuclear explosion. It may happen at the beginning of the nuclear war because of an effect that is as yet unpredicted.

A new scientific analysis of atmospheric nuclear tests and a prediction

During the cold war era of the 20 th century, the military budgets of the opposing powers permitted investigation of unusual phenomena that are not yet explained by the mainstream physical sciences. Some of these phenomena have been observed during nuclear tests, others in documented UFO cases, but much of the research has been hidden from university scientists and the public. Some information about this research appeared after the end of the 20th century cold war. Facilitated by the Internet, a significant amount of declassified material has leaked into the public space. The research has been mainly empirical despite the large military funding, and a strong physical theory appears to be lacking. Present research on antigravity by many private researchers and institutions is, in fact, an echo of classified research in the past. Internet communication facilitated the formation of informal research groups drawn from different organizations. The open exchange of ideas and publishing via the Internet allowed significant advances in a short period of time. As a result, annual conferences are organized regularly for the discussion of experiments and new theories. In recent years, research on so-called mass-less propulsion significantly increased. A large number of articles indicate that such research is now actively pursued at university levels in the USA, Europe and Russia. This type of research in only the USA involved at least 12 large academic institutions [1] in 2003.

One new physical phenomenon that resulted from antigravity research was reported at the 27 th Annual Meeting of the Society for Scientific Exploration, 25-28 June, 2008, in Boulder, CO, USA [2]. The unique gravito-inertial phenomenon achieved in the laboratory was called Stimulated Anomalous Reaction to Gravity (SARG). It was a result of years of research following successful theoretical predictions, and was supported by international private organizations. The theoretical and experimental research leading to the discovery of this effect were published at a number conferences and international meetings, and is the subject of a patent application [3,4,5].

In parallel with the laboratory experiments, extensive analysis was done on the effects of nuclear tests in the atmosphere using the physics behind the observed SARG effect. A large quantity of unclassified nuclear test data from both the USA and the former Soviet Union was used. Pictures and technical specs, as well as video material, are available via the Internet. The videos are useful for observing the dynamics in the first few seconds of the nuclear explosion when unusual phenomena take place. It was observed that an extremely large scale SARG effect takes place in the first few seconds or tens of seconds. The effect is stronger when the nuclear explosion takes place in the atmosphere between 200 m to 2 km above the ground. It is less strong at higher altitudes due to the rarefied atmosphere. Even for the non-scientist, the effect of antigravity is apparent in several videos such as the unclassified documentary movie entitled “Declassified U.S. Nuclear Test Film #70” [6]. The atmospheric nuclear test near the beginning of the documentary occurs at an altitude of 610 m from the ground. As the plasma from the nuclear explosion expands, a thick column of dust and condensed air begins to rise from the ground. It reaches the expanding plasma in about 20 sec. Small-diameter tornado-like columns also arise simultaneously, and this phenomenon is very common during atmospheric nuclear explosions. Note that the rising main column not only reaches the bulk of expanded plasma but also punches through it. The SARG effect explains the rising column and surrounding tornados. The nuclear explosion causes the formation of a vast quantity of expanding plasma. This plasma affects the physical vacuum in such a way that an antigravity effect is created below the nuclear explosion. The dust and condensed gases rise because of the antigravity effect. They obtain a vertical pulse momentum during the existence of the plasma resulting from the explosion, which may last for a few seconds to tens of seconds. The explosion also creates another detectable effect – a strong EM pulse. (In the laboratory experiment demonstrating the SARG effect, such a pulse is quite weak and is invoked by other means). The rising column and the expanding plasma create the well-known shape of the nuclear mushroom cloud. The same antigravity phenomenon with multiple tornados is also visible in the videos [7,8] of other atmospheric nuclear tests.

From 1945 to 1963 the USA conducted an extensive campaign of atmospheric nuclear tests, grouped into roughly 20 test series [9]. USSR also conducted extensive atmospheric nuclear tests in the period from 1949 to 1962. They are summarized in a Catalog of Worldwide Nuclear Testing edited by V. N. Michailov [10]. After the Limited Test Ban Treaty was signed in 1963, testing by the U.S., Soviet Union, and Great Britain moved underground. France continued atmospheric testing until 1974 and China did so until 1980.

In all the available information, there is no indication that simultaneous atmospheric nuclear tests separated by a finite distance have ever been performed. This has been our good fortune, as we will see. In a single atmospheric test, the antigravity effect is usually directed vertically upward. But what might happen if simultaneous tests within a finite time and distance were done? The disturbance of the physical vacuum would lead to an antigravity effect that is not vertical. Additionally, the two disturbances would interact and the columns from the rising dust and gases will be twisted. The new physics of this phenomenon predicts that the antigravity effect from the two explosions will be much stronger. This may cause a part of the atmosphere to be thrown into space. Further, it is possible that a self-supported tornado-like effect may extend the life of the phenomenon, so a significant fraction of the earth’s atmosphere may be sucked into space. This is more than just speculation since exactly such an effect was observed on the Sun by some solar orbit satellites [11,12]. The video clip on the National Geographic website [13] clearly shows the dynamics of the solar tornado extended into space. Now scientists claim that such a tornado is responsible for throwing large quantities of solar gaseous mass into space [14]. The phenomenon observed at the Sun could happen on the Earth during simultaneous nuclear atmospheric explosions that create similar conditions.

To understand the gravity effects, one must have a correct model of the physical vacuum. The model adopted about 100 years ago is now not supported by laboratory experiments. We may think that the space outside the earth’s atmosphere is empty but it still has the properties of the physical vacuum, and many experiments show that it is not void. This new understanding is completely unknown to military advisors and politicians. They don’t have a clear idea what could happen during multiple nuclear explosions in the atmosphere because, fortunately, such experiments have never been done. We must not think that the atmosphere is something permanent and cannot be destroyed. The planet Mars is a good example of an atmosphere’s vulnerability. Once Mars had an atmosphere. This is evident from apparent surface erosion from rivers. Now the atmospheric pressure on Mars is about 0.1% of Earth’s atmospheric pressure. Mars lost its atmosphere probably because of some natural event such as a huge volcanic eruption.

If the policy of preemptive nuclear strike is applied during a military conflict, there will likely be multiple cases of simultaneous nuclear explosions within a limited range and time. The probability is high that conditions will be created which can result in the loss of a fraction of the Earth atmosphere. Let us describe the consequences of this worst-case scenario that might develop during the initial phase of the nuclear strikes.

If an atmospheric sucking-tornado effect occurs somewhere, the first effect will be a huge windstorm that equalizes the atmospheric pressure. This, of course, will not stop the nuclear strikes. The worst case is that the global atmospheric pressure will drop below some critical level. It is well known that human beings are quite sensitive to changes in atmospheric pressure. (Even a trained mountain climber could not climb a peak higher than 5 km without an oxygen mask). At some low level of atmospheric pressure, a person loses consciousness. Since the effect of a pressure drop will be permanent, there is no chance of returning to consciousness. Protective measures exist to counter all known effects of a nuclear explosion: i.e., direct radiation, shock waves, and radioactivity. Protection from reduced atmospheric pressure, however, is impossible. In the worst-case scenario, there will be no survivors. It does not matter that you are rich or poor, living in a highly developed or a poor country, in an urban or low populated area. Everyone on Earth will die. This may happen in a time interval of 1-3 days. The dead people will lay unburied together with animals. Microbes and fungi will survive while the biomass of Earth’s human and animal population slowly disintegrates. This will be a very tragic end to Earth’s civilization; a civilization that reached its apogee in order to destroy itself. There will be no one left to document the end of humankind.

#### Restudied again and concludes the same. This is with bunkers as well

Dr. Stoyan **Sarg 15**, PhD Physics, Director of the Physics Research Department at the World Institute for Scientific Exploration, “The Unknown Danger of Nuclear Apocalypse,” <https://www.foreignpolicyjournal.com/2015/10/09/the-unknown-danger-of-nuclear-apocalypse/>, cc

With the new NATO plan for installation of nuclear tactical weapons in Europe, nuclear missiles may reach Moscow in only 6 minutes, and the opposite case is also possible in the same time. The question is: how can we be sure that this will not be triggered by a human error or computer malfunction. An adequate reaction dictated by the dilemma “to be or not to be” and the concept of preventive **nuclear strike** may lead to a nuclear consequence that is difficult to stop. At the present level of distributed controlled systems and military global navigations, this will lead to **unstoppable global nuclear war**. However, there is something not predicted, of which the military strategists, politicians and powerful forces are not aware. Probably, it will **not** be a **nuclear winter** that they hope to survive in their **underground facilities**. The **most probable** consequence will be a **partial loss** of the **Earth’s atmosphere** as a result of one or many **powerful simultaneous tornadoes** caused by the **nuclear explosions**.

In a tornado, a powerful **antigravitational** effect takes place. The official science does not have an adequate explanation for this feature due to an incorrect concept about space. The antigravitational effect is not a result of the circling air. It is a specific physical effect in the aether space that is dismissed in physics as it is currently taught. Therefore, the effective height of this effect is not limited to the height of the atmosphere. Then in the case of many simultaneous **powerful tornadoes**, an **effect** of **suction** of the **earth atmosphere into space** might take place. Such events are **observed on the Sun** and the present physical science does not have an explanation for them. The antigravitational effect is accompanied by specific electric and magnetic fields with a twisted shape. This is observed in tornado events on the Sun. Some effects in the upper Earth atmosphere known as sprites have a similar combination of electrical and magnetic fields but in a weaker form. They are also a mystery for contemporary physical science.

At the time of **atmospheric nuclear tests**, made in the last century, a number of **induced tornadoes** are observed near the **nuclear mushroom** as shown in Figure 1.

The strongest antigravitational effect, however, occurs in the central column of the formed nuclear mushroom. The analysis of underwater nuclear tests also indicates a strong antigravitational effect. It causes a rise of a vertical column of water. In the test shown in Figure 2, the vertical column contains millions tons of water.

Thermonuclear bombs are **multiple times more powerful**. The largest thermonuclear bomb of the former Soviet Union tested in 1961 is 50 megatons. It is 3,300 times more powerful than the bomb dropped by USA on Hiroshima at the second world war and may kill millions.

It is known that Mars once had liquid water and consequently an atmosphere that has mysteriously disappeared. If the scenario described above takes place, the Earth will become a **dead planet like Mars**. The powerful politicians, military adventurers and their financial supporters must be aware that even the most secured **underground facility** will not save them if a global nuclear conflict is triggered. Their disgraced end will be more miserable than the deaths of the billions of innocent human beings, including the animal world.

### Impact---Nuke War = Planetary Explosion = Extinction

#### Nuclear war will result in planetary explosion

**Chalko 03**

Dr. Tom Chalko, MSC, PhD, head of Australia's physics, 2003 (March 3, Scientific Engineering Research, "Can a Neutron Bomb accelerate Global Volcanic Activity?", http://sci-e-research.com/neutron\_bomb.html)

**Consequences of using modern nuclear weapons can be far more serious than previously imagined. These consequences relate to the fact that most of the heat generated in the planetary interior is a result of nuclear decay.** Over the last few decades, **all superpowers have been developing so-called "**[neutron bombs](http://www.manuelsweb.com/sam_cohen.htm)". These bombs are designed to emit intensive neutron radiation while creating relatively little local mechanical damage. Military are very keen to use neutron bombs in combat, because lethal neutron radiation can peneterate even the largest and deepest bunkers. **However, the military seem to ignore the fact that a neutron radiation is capable to reach significant depths in the planetary interior.** In the process of passing through the planet and losing its intensity, a neutron beam stimulates nuclei of radioactive isotopes naturally present inside the planet to disintegrate. This disintegration in turn, generates more neutron and other radiation. The entire process causes increased nuclear heat generation in the planetary interior, far greater than the initial energy of the bomb. It typically takes many days or even weeks for this extra heat to conduct/convect to the surface of the planet and cause increased seismic/volcanic activity. Due to this variable delay, nuclear tests are not currently associated with seismic/volcanic activity, simply because it is believed that there is no theoretical basis for such an association. Perhaps you heard that after every major series of nuclear test there is always a period of increased seismic activity in some part of the world. This observable fact CANNOT be explained by direct energy of the explosion. The mechanism of neutron radiation accelerating decay of radioactive isotopes in the planetary interior, however, is a VERY PLAUSIBLE and realistic explanation. The process of accelerating volcanic activity is nuclear in essence. Accelerated decay of unstable radioactive isotopes already present in the planetary interior provides the necessary energy. **The TRUE danger of modern nuclear weaponry is that their neutron radiation is capable to induce global overheating of the planetary interior, global volcanic activity and, in extreme circumstances, may even cause the entire planet to explode.**

## Theirs

#### No runaway AI and no impact.

**Pierce 22** [Rj Pierce, 2-17-2022, "Why You Shouldn't Be Scared Of AI Taking Over The World ", Tech Times, https://www.techtimes.com/articles/271938/20220217/why-ai-wont-take-over-the-world.htm, DOA: 6-24-2022 //ArchanSen]

AI has been the subject of countless popular TV shows and movies over the years-just not in a relatively positive way. In these shows, it always seems like artificial intelligence will decide to completely wipe out humanity and civilization from existence. It's a bleak "prediction," but does it actually have any basis in reality?

According to several scientists, **the feared dangers of AI aren't much of an existential threat to humanity as a whole**. And that depends on one thing: whether it is even possible for us to create artificial intelligence way smarter than we are, writes ScienceAlert.

Current-Gen AI Is Still Pretty 'Weak'

The AI that exists right now is pretty powerful in its own right. It is what's being used for things like self-driving cars, facial recognition software, and even Google recommendations. But the thing with current-gen AI is that it's considered "narrow" or "weak."

While this kind of artificial intelligence is already quite good, **they're often only capable of doing one thing exceptionally**, according to LabRoots. If you try to make them do something else while doing something they're good at, these AIs will fail because **they lack the necessary data to perform it**.

Current-generation artificial intelligence still falls short of tasks that will always require abilities that only humans possess, writes Forbes. For instance, experienced surgeons are still the best choice for performing surgeries, with their fine motor skills and skill at perceiving individual situations.

You also can't use an AI to replace HR professionals, because the job will require a deep, intrinsic understanding of human reactions that a machine just doesn't have, no matter how "advanced" it might be. It is these kinds of situations where combining machine and human intelligence still reigns supreme. The human element provides the machine with the necessary context, while the latter is put to work crunching numbers and giving recommendations.

Machines Are Just Called 'Intelligent' For Their Ability To Learn

In an article by The Conversation, they put this specific argument forward. A machine can always "learn" if it is fed data about the task it's meant to achieve. Sure, it can process information much faster than a human can (and perhaps even come up with solutions no person can ever think of), but it doesn't make the machine smarter than a human at all.

Here's one situation where machine learning is still way behind human learning. Take a toddler, for instance. That child can learn how to do a specific task within seconds just by watching somebody do it. A machine can only learn something if it is fed an **extremely massive amount of data**, which it uses when performing trial-and-error according to Synthesys.

#### No AI extinction -- it’s impossible and centuries away at best.

Oren **Etzioni, 16** - CEO of the Allen Institute for Artificial Intelligence and Professor of Computer Science at the University of Washington; "Most experts say AI isn’t as much of a threat as you might think," MIT Technology Review, 9-20-2016, https://www.technologyreview.com/s/602410/no-the-experts-dont-think-superintelligent-ai-is-a-threat-to-humanity/

To get a more accurate assessment of the opinion of leading researchers in the field, I turned to the Fellows of the American Association for Artificial Intelligence, a group of researchers who are recognized as having made significant, sustained contributions to the field.

In early March 2016, AAAI sent out an anonymous survey on my behalf, posing the following question to 193 fellows:

“In his book, Nick Bostrom has defined Superintelligence as ‘an intellect that is much smarter than the best human brains in practically every field, including scientific creativity, general wisdom and social skills.’ When do you think we will achieve Superintelligence?”

Over the next week or so, 80 fellows responded (a 41 percent response rate), and their responses are summarized below:

In essence, according to 92.5 percent of the respondents, superintelligence is **beyond the foreseeable horizon**. This interpretation is also **supported** by written comments shared by the fellows.

Even though the survey was anonymous, 44 fellows chose to identify themselves, including Geoff Hinton (deep-learning luminary), Ed Feigenbaum (Stanford, Turing Award winner), Rodney Brooks (leading roboticist), and Peter Norvig (Google).

The respondents also shared several comments, including the following:

“Way, way, way more than 25 years. **Centuries most likely**. But not never.”

“We’re competing with **millions of years’ evolution of the human brain**. We can write single-purpose programs that can compete with humans, and sometimes excel, but the world is not neatly compartmentalized into single-problem questions.”

“Nick **Bostrom is** a professional scare monger. His Institute’s role is to find existential threats to humanity. He sees them everywhere. I am tempted to refer to him as **the** ‘**Donald Trump’** **of AI.**”

Surveys do, of course, have limited scientific value. They are notoriously sensitive to question phrasing, selection of respondents, etc. However, it is the one source of data that Bostrom himself turned to.

Another methodology would be to extrapolate from the current state of AI to the future. However, this is difficult because we do not have a quantitative measurement of the current state of human-level intelligence. We have achieved superintelligence in board games like chess and Go (see “Google’s AI Masters Go a Decade Earlier than Expected”), and yet our programs failed to score above 60 percent on eighth grade science tests, as the Allen Institute’s research has shown (see “The Best AI Program Still Flunks an Eighth Grade Science Test”), or above 48 percent in disambiguating simple sentences (see “Tougher Turing Test Exposes Chatbots’ Stupidity”).

There are many valid concerns about AI, from its impact on jobs to its uses in autonomous weapons systems and even to the potential risk of superintelligence. However, predictions that superintelligence is on the foreseeable horizon **are not supported** by the available data. Moreover, doom-and-gloom predictions often **fail to consider the potential benefits** of AI in preventing medical errors, reducing car accidents, and more.

Finally, it’s possible that AI systems could collaborate with people to create a **symbiotic superintelligence**. That would be very different from the pernicious and autonomous kind envisioned by Professor Bostrom.

#### AGI is structurally impossible AND harmless---conventional threats outweigh.

Hoel ’21 [Erik; April 20; Neuroscientist and assistant research professor at Tufts University, former postdoctoral researcher at Columbia University, Ph.D. in Neuroscience from the University of Wisconsin Madison; The Intrinsic Perspective, “Superintelligence is impossible,” <https://erikhoel.substack.com/p/superintelligence-is-a-free-lunch>]

I don’t really buy this sort of argument, but it’s nice to see some doubt around this issue. An increase of skepticism is important because there’s been a great deal of intellectual resources devoted to what is, in the end, a hypothetical risk. Of course, for getting people to seriously contemplate existential threats is something thinkers like Nick Bostrom deserve serious credit for, as well as credit for crafting evocative thought experiments. But I agree with Kevin Kelly and Ted Chiang that the risk of this particular existential threat has been radically overblown, and, more importantly, I think the reasons why the claims are overblown are themselves interesting and evocative.

First, some definitions. Superintelligence refers to some entity compared to which humans would seem like children, at minimum, or ants, at maximum. The worrying runaway threat is that something just a bit smarter than us might be able to build something smarter than it, etc, so the intelligence ratchet from viewing humans as children to viewing humans as ants would occur exponentially quickly. While such an entity could possibly adopt a beneficent attitude toward humanity, since it’s also incomprehensible and uncontrollable, its long-term goals would probably be orthogonal to ours in such a way that “eliminates our maps” as it were. Regardless, even just our fates being so far outside of our control constitutes an existential threat, especially if we can’t predict what the AI will do when we ask it for something (this is called the alignment problem).

Certainly it’s an interesting hypothetical scenario. But all existential threats are not equal. Some are so vanishingly small in their probabilities (rogue planets, like in the film Melancholia) that it would be madness to devote a lot of time to worrying about them. And at this point my impression from the tremors in the world wide web is that the threat of superintelligent AI is being ranked by a significant number of thinkers in the same category as the threat of nuclear war. Here’s Elon Musk, speaking at MIT back in 2014:

“I think we should be very careful about artificial intelligence. If I had to guess at what our biggest existential threat is, it’s probably that.”

Consider that statement. Because the obvious answer to the question of the biggest existential threat, which people have been giving for decades, is the threat of nuclear annihilation. After all, the risk of civilizational reset brought about by a global nuclear war is totally concrete and has almost happened on multiple occasions. Whereas the risk of AI is totally hypothetical, has a host of underlying and unproven assumptions, and has never even gotten close to happening.

To deserve its title as leading or even top-tier existential threat, the arguments for the risk of superintelligent AI have to be incredibly strong. Kevin Kelly in his article does a good job listing five pretty sensible objections (wording is his):

1. Intelligence is not a single dimension, so “smarter than humans” is a meaningless concept.

2. Humans do not have general purpose minds, and neither will AIs.

3. Emulation of human thinking in other media will be constrained by cost.

4. Dimensions of intelligence are not infinite.

5. Intelligences are only one factor in progress.

While he lists five separate objections, I think most actually spring naturally from using a specific framework to think about intelligence. Here, I’d like to explore where I think the fundamental disagreement between believers and non-believers in superintelligence lies. Roughly, there are two frameworks: either an evolutionary one (non-believers) or a deistic one (believers).

Note that I don’t mean to imply that the deistic view is wrong merely because I’ve labeled it as deistic; plenty of really wonderful thinkers have had this framework and they aren’t adopting it for trivial reasons. Rather it’s deistic in that it assumes that intelligence is effectively a single variable (or dimension) in which rocks lie at one end of the spectrum and god-like AI lies at the other end. It’s “deistic” because it assumes that omniscience, or something indistinguishable to it from the human perspective, is possible.

All of the points Kevin Kelly makes actually stem from him eschewing the deistic understanding of intelligence in favor of the evolutionary. Which framework is correct? The demarcation between the two frameworks begins with an image, a scale laid out in Nick Bostrom’s book Superintelligence:

This is the deistic frame in a nutshell: there’s some continuum from mice up to Einstein up to near-omniscient recursively self-improved AI.

While Kelly immediately objects to this by saying that there is no agreed upon definition of general intelligence, I think actually there are two broad options. One is to define intelligence based on human intelligence, which can be captured (at least statistically) with IQ. The Intelligence Quotient holds up well across life, is heritable, and is predictive for all the things we associate intelligence with. Essentially, we can use the difference between low-intelligence people and high-intelligence people as a yardstick (this is how Chiang is arguing as well).

But clearly rating a superintelligence using an IQ test is useless. We wouldn’t use Einstein as a metric for a real superintelligence of the variety Bostrom is worried about. The danger isn’t just from an AI with an exceptionally high IQ (since it’s not like high IQ people run the world anyways). Rather, the danger comes from the possibility of a runaway process of a learning algorithm that creates an AI with a god-like IQ, something different in kind. To examine is that’s possible we need a more abstract and generalizable notion of intelligence than IQ tests.

A mathematical definition of intelligence is actually given by Legg and Hutter in their paper “Universal intelligence: a definition of machine intelligence.” Taking their point broadly, the intelligence of an agent is the sum of the performance of that agent on all possible problems, weighted by the simplicity of those problems (simple problems are worth more). A superintelligent entity would then be something that scores extremely high on this scale.

So universal intelligence is at least describable. Interestingly, Einstein scores pretty low on this metric. In fact, every human would score pretty low on this metric. This is because the space of all problems is mostly stuff that human beings are really bad at, like picking out the same two color pixels on a TV screen (and three pixels triads, and so on). This scale or metric for intelligence fits perfectly with the deistic framework for intelligence, making it imaginable or at least definable that intelligence is a dial that can be turned up indefinitely.

In contrast, let’s now introduce the evolutionary framework. In this framework, intelligence is really about adapting to some niche portion of the massive state space of all possible problems. Its inspiration is On the Origin of Species, the closing of which I’ll quote in full because it’s such a wonderful paragraph:

It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with reproduction; Inheritance which is almost implied by reproduction; Variability from the indirect and direct action of the conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less improved forms. Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone circling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved.

In the evolutionary framework different intelligences live together on a tangled bank (although here the bank is pretty abstract). This is pretty much the way our artificial intelligences live together right now. One AI to fly the plane, another AI to filter spam from email, and so on.

The evolutionary framework of intelligence doesn’t really allow for a superintelligence. To draw on something specific to support the evolutionary framework, consider the “No Free Lunch” theorem. Taken from the abstract of the paper by Wolpert and Macready that defines the theorem:

“A number of “no free lunch” (NFL) theorems are presented which establish that for any algorithm, any elevated performance over one class of problems is offset by performance over another class.”

The proof, which there are multiple versions of in the field of machine learning, search, and optimization, is highly relevant to the field of intelligence research. No Free Lunch means that no single model, or optimization, works best for all circumstances.

However, I don’t want to rely directly on the math or the specific proof itself, as these kinds of things are always limited in their universality by their assumptions. The “No Free Lunch” theorems are true, but they are also in the context of the entirety of possibility space (without weighing these spaces by the likelihood of their existence). I think the No Free Lunch theorem should instead be thought of as a concrete example of the more generalizable idea. Some sort of broader “No Free Lunch principle” (rather than theorem), that applies generally across evolution, intelligence, learning, engineering, and function.

First, an argument by analogy: consider the absurdity of designing a “superorganism” that has higher fitness in all possible environments than the highest fitness of any extant organism in any of those environments. While such an entity is definable, it is not constructible. It would need to be more temperature resistant than deep-vent bacteria, more hardy than a tardigrade, need to double faster than bacteria, hunt better than a pack of orcas, and, well, you get the idea. While it might be definable in terms of a fitness optimization problem (just wave your hands about precisely how it is optimizing for fitness), there isn’t any actual such thing as a universal organism that has a high fitness in all possible, or even just likely-here-on-Earth, environments. Again, a superorganism that is highly fit in every environment is definable, but not possible.

This particular free lunch is impossible in evolution because there’s no way to increase an organism’s fitness in regard to all niches or contexts. In fact, it’s probably the case that increasing fitness in regards to any particular environment necessarily decreases fitness in regards to other environments. While environments on Earth aren’t uniform in their likelihood, they are incredibly variable and they do change quickly. We can make a general claim that the more changeable an environment, and the more the likelihood is spread out over diverse environments, the more generalized No Free Lunch principle is likely to apply.

In fact, I think it’s precisely this No Free Lunch principle that actually generates the endless forms of evolution. A mutation may increase the fitness of an organism with regard to the current environment, but it will often, perhaps always, decrease fitness in regard to other environments. Since the environment is always changing, this will forever cause a warping and shifting of where organisms are located in the landscape of possible phenotypes. The No Free Lunch principle is why there’s no end state to evolution. And since there are never any free lunches, evolution is the one game nobody can stop playing. It’s the game that lasts forever.

This same sort of reasoning about fitness (in regards to the environment) applies also to intelligence (in regards to a set of problems). While a superintelligence is definable, it’s not possible. There’s just no one brain, or one neural network, that plays perfect Go, can pick the two matching pixels of color out of the noise of a TV screen in an instant, move with agility, come up with a funny story, bluff in poker, factor immensely large numbers quickly, and plan world domination.

For my PhD I studied Integrated Information Theory under Giulio Tononi, trying to come up with mathematical ways to measure when when a system breaks down into subsystems. It’s hard to make big integrated systems, let alone those that can perform multiple functions, and I’d posit there is no integrated constructible system that can perform all functions perfectly.

The No Free Lunch principle shows up in intelligence because whenever you’re adapting a neural network or an organism to perform in some way you’re implicitly handicapping it in some other way. The infamous difficulty of getting a neural network trained on one task to perform well on another task is implicit proof of this.

​I recently saw a practical example of the No Free Lunch principle as specifically concerns AI, in a talk given at Yhouse in New York City by Julian Togelius, who studies intelligence by designing AIs that play computer games. Here’s a figure from a paper of his where they researched how different controllers (AIs) performed across a range of different computer games.

Basically, no controller (read, simple AI) does well across the full selection of games (and the games aren’t actually even that different). It’s not like they are trying directly to build superintelligence, but it’s a telling example of how the No Free Lunch principle crops up even in what seem like small domains of expertise.

Even if there were a general intelligence that did okay across a very broad domain of problems, it would be outcompeted by specialists willing to sacrifice their abilities in some domains to maximize abilities in others. In fact, this is precisely what’s happening with artificial neural networks and human beings right now. It’s the generalists who are being replaced.

If the No Free Lunch principle applies to intelligence this in turn indicates there will forever be endless forms of intelligence. Changes to the neural architecture of a network or a brain may help with the current problems at hand, but this will necessarily decrease its capability of solving other types of problems. Overall, a tangled bank will emerge.

#### No quantum vacuum mining

Dr. Masroor Bukhari 16, Professor of Physics at Jazan University, Ph.D. in Nuclear & Particle Physics from the University of Houston, MSc in Physics from University of Sind, Former Research Fellow and Post-Doc at University of Houston, “How Can We Harness Zero Point Energy?”, Quora, 6/7/2016, https://www.quora.com/How-can-we-harness-zero-point-energy

This is a very important question, I believe it is imperative to answer and clarify this concept to general public, since a lot of science fiction and pseudo-science has got attached to it, and some fraudulent individuals are trying to coax people into thinking that it can generate useful energy or work. Zero-point energy has become like an urban legend, which though true in its basic scientific roots, has no useful potential in our actual real-world life in terms of fulfilling our energy needs. It is similar to the wrong idea of using ordinary water at normal temperature and pressure to propel turbines or engines and drive our vehicles. The laws of thermodynamics do not permit these. As I have said many times before, when Laws of Thermodynamics do not permit something, then that thing cannot have a physical existence, as far as our knowledge of physics is concerned.

First of all, let’s look at what zero-point energy is. Zero-point energy is a non-vanishing energy which is there even when a particle or system has reached its ground state. Its magnitude is

E=ħω/2

and you can say it is the energy of the quantum vaccum as well as the energy of the ground state, it is energy of a harmonic oscillator like pendulum, but of quantum nature, which has no motion yet it has a small amount of energy left as residual energy in its lowest energy (the ground) state.

It is similar to a residual amount of motion or momentum any physical or mechanical system would have owing to the uncertainty principle. And since the amount of uncertainty is proportional to the extremely small value of the Planck constant, you can imagine that the magnitude its extremely small.

However, it plays a momentous role in cosmology, since some models allude the existence of the Cosmological constant to this energy.

Once a system reaches its ground state, it continues to have fluctuations in its momentum/energy and position (once again owing to the uncertainty principle), these are known as quantum fluctuations or vacuum fluctuations (when in vacuo) and they have associated with them energy known as the zero-point energy. Some physicists term these as zero-point fields (ZPF), which is true. Thus, ZPE and ZPF are legitimate scientific terms in physics, borrowing their existence from the quantization of classical fields which become quantum fields. (To be more exact, once you solve the problem of a classical harmonic oscillator quantum mechanically, you find the energy eigenvalues including a non-vanishing energy for the zeroth or ground state.)

However, it is very important to understand this concept in its true context. ZPF and ZPE are legitimate physical terms, but their usage in our daily life (especially its proposed commercial usage) is not a real or legitimate idea. It is not an actual amount of energy which can do significant work on a system or which can be extracted out of vacuum without spending equal amount of work on it, since you cannot measure it unless you add some work to the system to measure it. In simple words, you have to spend an equal or approximately proportional amount of energy on the vacuum to extract work or energy out of it. In simple words, this energy cannot be harnessed to do anything useful in our life. It is similar to the concept of making gold from Uranium. You can do it but you would end up spending more amount of energy and money on doing it.

Some people would argue and present the Casimir Effect as the manifestation of Zero-point energy. You have to understand that Casimir effect may or may not being a manifestation of ZPE and not Van der Waal forces (as some phyisicists have argued), has its effect at very small scales such as meso- and nano-scales, and the effect can not be amplified at large scales.

In short, unfortunately we cannot extract any useful work out of the ZPE or ZPF fields.