EXISTENTIAL THREATS 101

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Introduction

Existential Threats 101 is an infographic collection examining threats that could affect humanity on an existential scale. The collection begins by defining what counts as an existential threat, establishing the subject before turning to specific natural, technological, biological, environmental, and systemic risks. Its scope is broad, bringing together familiar catastrophic scenarios, risks associated with human development and technological change, and the possibility of dangers that have not yet been anticipated.

The first infographic, “WHAT COUNTS AS AN EXISTENTIAL THREAT?”, provides the collection’s framing subject. It is followed by “NUCLEAR WAR AND NUCLEAR WINTER” and “ENGINEERED PANDEMICS AND BIOLOGICAL CATASTROPHES,” which address large-scale threats arising from weapons, conflict, biological processes, and human intervention. “ADVANCED ARTIFICIAL INTELLIGENCE AND LOSS OF HUMAN CONTROL” extends the discussion to advanced technology and the prospect of diminished human control.

The collection then examines threats originating in planetary and geological processes. “ASTEROID AND COMET IMPACTS” considers impacts from objects beyond Earth, while “SUPERVOLCANIC ERUPTIONS AND GLOBAL VOLCANIC WINTER” addresses extreme volcanic events and their global implications. The sequence next turns to interconnected human and environmental systems through “CLIMATE CHANGE, TIPPING POINTS, AND SYSTEMIC GLOBAL FAILURE” and “GLOBAL FOOD-SYSTEM COLLAPSE.” These topics place climate conditions, thresholds, food systems, and broader patterns of failure within the same field of examination.

The final two infographics broaden the focus from individual hazards to the stability of civilization and the limits of present knowledge. “CASCADE FAILURE OF GLOBAL TECHNOLOGICAL CIVILIZATION” addresses the possibility that failures may spread across interconnected technological systems. “UNKNOWN RISKS: WHAT HAS HUMANITY NOT ANTICIPATED?” closes the collection by considering risks that fall outside currently recognized categories or expectations.

Taken as a whole, the collection progresses from definition to a set of distinct threat areas, then toward more interconnected and uncertain forms of global disruption. Its recurring theme is the range of conditions that may be considered existential, from acute events such as nuclear war, biological catastrophe, asteroid impact, or supervolcanic eruption to gradual or cascading failures involving climate, food, technology, and human control. The organization allows these subjects to be viewed individually while also showing how the collection moves toward questions of systemic interdependence and uncertainty.

Existential Threats 101 provides a structured visual reference for examining the categories and progression of existential threats presented in the collection.

Section 1: Defining Existential Threats

1 infographics

This infographic provides the foundational definition needed to frame all subsequent topics.

WHAT COUNTS AS AN EXISTENTIAL THREAT?

UNDERSTANDING THE DIFFERENCE BETWEEN DISASTERS, CATASTROPHES, CIVILIZATION-ENDING EVENTS, AND EXISTENTIAL THREATS

THE SPECTRUM OF SEVERITY

ORDINARY DISASTERS

Serious but localized or short-lived events that cause harm and disruption in a region or community.

Examples: earthquakes, floods, wildfires, severe storms

GLOBAL CATASTROPHES

Large-scale events with worldwide impacts that cause mass loss of life, severe economic damage, and long-term hardship.

Examples: pandemics, global financial collapse, major asteroid impact

CIVILIZATION-ENDING EVENTS

Events that cause the collapse of human civilization and social systems, leading to a return to pre-industrial or pre-technological conditions.

Examples: supervolcano eruption, extreme climate change, nuclear war

EXISTENTIAL THREATS

Events that could permanently end humanity's potential for the indefinite future, either by ending human life or eliminating our potential to flourish.

Examples: human extinction, loss of civilizational potential, permanent collapse into irreversible stagnation

KEY CRITERIA OF AN EXISTENTIAL THREAT

EXTREME SEVERITY	Could permanently eliminate humanity or irreversibly end our potential.
PERMANENCE	The effects are lasting on timescales far beyond any practical recovery.
SCOPE	Impacts humanity as a whole, not just a region or group.
BEYOND RECOVERY	No realistic path exists to restore lost potential or resume normal progress.
DEEP UNCERTAINTY	We lack full knowledge of risks, especially from novel or emerging technologies.

COMPARING THE CATEGORIES

	ORDINARY DISASTERS	GLOBAL CATASTROPHES	CIVILIZATION-ENDING EVENTS	EXISTENTIAL THREATS
Scale	Local or regional	Global	Global	Global
Impact on Humanity	Limited	Massive	Overwhelming	Terminal or irreversible
Damage to Civilization	Minimal	Severe	Collapse	End of potential
Potential for Recovery	High	Possible (over time)	Unlikely	None
Long-Term Consequences	Short-term disruption	Long-term hardship	Loss of civilization	Permanent loss

WHY LONG-TERM POTENTIAL MATTERS

Humanity's future potential is vast. Protecting it means keeping the door open to knowledge, health, prosperity, and meaning for generations to come.

Some risks build slowly or arise from our success. Focusing only on immediate dangers can leave us unprepared for tomorrow's threats.

Wise stewardship means investing in safety now to preserve options and prevent irreversible loss later.

EXAMPLES: NON-EXISTENTIAL VS EXISTENTIAL

TYPICALLY NOT EXISTENTIAL

- Seasonal influenza
- Regional flooding
- Economic recession
- Moderate asteroid impact

POSSIBLY EXISTENTIAL (CONTEXT DEPENDENT)

- Engineered pandemic
- Nuclear war
- Runaway AI
- Climate tipping cascade
- Loss of civilizational potential

TAKEAWAY

Not all bad outcomes are existential. Existential threats are those that could permanently end humanity or our potential for the indefinite future. Understanding this difference helps us focus our attention and resources on the risks that matter most.

Section 2: Human-Caused Catastrophic Risks

3 infographics

These topics present major existential threats arising directly from human technology, conflict, or biological activity.

NUCLEAR WAR AND NUCLEAR WINTER

FROM DETONATION TO GLOBAL DISRUPTION—UNDERSTANDING THE RISKS AND PREVENTING THE UNTHINKABLE

IMMEDIATE EFFECTS OF NUCLEAR WAR

BLAST EFFECTS

Powerful shock waves cause widespread destruction, building collapse, injuries, and loss of life.

FIRESTORMS

Multiple fires merge into intense firestorms that consume neighborhoods, ignite new blazes, and overwhelm emergency response.

RADIATION HAZARDS

Nuclear weapons release heat and radiation that cause acute illness, long-term health effects, and environmental contamination.

INFRASTRUCTURE COLLAPSE

Critical systems—power, water, communications, transport, and healthcare—may fail, complicating rescue and recovery.

HUMANITARIAN CRISIS

Mass casualties, displacement, and overwhelmed services lead to urgent shortages of medical care, shelter, clean water, and essentials.

NUCLEAR WINTER: HOW IT HAPPENS

Urban fires and firestorms inject huge amounts of soot into the upper atmosphere.

Soot rises high into the stratosphere, where there is little rain to wash it out.

Soot spreads around the globe, blocking sunlight and trapping heat, disrupting the climate system.

Global cooling and severe weather disrupt ecosystems, agriculture, and human societies.

THE PATH FROM CONFLICT TO FOOD INSECURITY

1 NUCLEAR CONFLICT

- Large-scale nuclear exchange
- Multiple cities targeted
- Immediate destruction and chaos

2 FIRES AND SOOT

- Widespread urban fires
- Soot injected into the upper atmosphere
- Soot spreads globally

3 CLIMATE DISRUPTION

- Reduced sunlight reaches the surface
- Global cooling occurs
- Changes in rainfall patterns and extreme weather

4 ECOSYSTEM IMPACTS

- Disrupted growing seasons
- Ecosystem stress
- Loss of biodiversity
- Ocean and freshwater disruptions

5 AGRICULTURAL DECLINE

- Lower crop yields
- Soil degradation
- Livestock and fisheries affected

6 FOOD INSECURITY AND FAMINE RISK

- Food shortages intensify
- Malnutrition and disease rise
- Social instability and conflict risk increase

LONGER-TERM SYSTEMIC DISRUPTION

POLITICAL INSTABILITY

Governance breakdowns, weakened institutions, and conflict over scarce resources.

ECONOMIC COLLAPSE

Disrupted trade, damaged infrastructure, and loss of productivity cause severe economic downturn.

SOCIAL STRAIN

Displacement, inequality, and loss of services erode social cohesion and trust.

HEALTH CONSEQUENCES

Radiation exposure, disease, malnutrition, and mental health impacts persist for generations.

GENERATIONAL IMPACT

Education disruption and long-term hardship limit opportunities for future generations.

PREVENTION AND RISK REDUCTION MATTER

DIPLOMACY FIRST

Strong diplomacy and dialogue reduce tensions and prevent miscalculation.

ARMS CONTROL

Arms control and verification limit risks and build strategic stability.

EARLY WARNING

Invest in early warning systems and communication channels.

CRISIS MANAGEMENT

Maintain crisis management plans and reduce launch-on-warning postures.

COLLECTIVE SECURITY

Global cooperation and a shared commitment to peace protect humanity's future.

NUCLEAR WAR THREATENS HUMAN SURVIVAL. UNDERSTANDING THE RISKS EMPOWERS US TO PREVENT CONFLICT, REDUCE NUCLEAR DANGERS, AND BUILD A SAFER, MORE RESILIENT WORLD FOR FUTURE GENERATIONS.

ENGINEERED PANDEMICS AND BIOLOGICAL CATASTROPHES

UNDERSTANDING BENEFITS, RISKS, AND OUR RESPONSIBILITY TO PREPARE AND PROTECT

BIOTECHNOLOGY: POWERFUL TOOLS FOR HUMANITY

Biotechnology enables life-saving medicines, vaccines, and diagnostics. It also improves agriculture, environmental protection, and industrial processes—driving health, food security, and economic progress.

BETTER HEALTH
Vaccines, therapies, and rapid diagnostics save and improve lives.

FOOD SECURITY
Stronger crops and sustainable practices boost food supplies.

ENVIRONMENTAL BENEFITS
Biotech supports cleaner solutions and conservation.

INDUSTRIAL INNOVATION
Bioprocesses create cleaner, cheaper, and more efficient products.

SCIENTIFIC DISCOVERY
Research advances knowledge and unlocks new cures.

BIOTECHNOLOGY RISKS: HOW HARM CAN OCCUR

The same tools that heal can be misused or mishandled. Risks arise through accidental release, deliberate misuse, or the emergence of dangerous pathogens.

ACCIDENTAL RELEASE
- Lab errors or equipment failures
- Inadequate safety practices
- Natural disasters or power losses
- Improper handling or disposal

Unintentional events can allow dangerous agents to escape.

DELIBERATE MISUSE
- Weaponization of pathogens
- Targeted attacks on populations
- Disruption of societies
- Use of dual-use technologies

Intentional acts can cause harm, fear, and societal instability.

DANGEROUS PATHOGENS
- Engineered for higher transmissibility
- Increased severity or immune escape
- Resistance to treatments
- Novel combinations and variants

Highly transmissible or lethal agents can overwhelm defenses.

WHY ENGINEERED BIOLOGICAL RISKS DIFFER FROM NATURAL OUTBREAKS

DESIGN AND MANIPULATION
Pathogens can be altered to enhance traits like spread, virulence, or immune evasion.

UNNATURAL COMBINATIONS
Engineered agents may combine elements not found together in nature.

UNPREDICTABLE BEHAVIOR
Modifications can create unpredictable changes in how agents act.

HARDER TO DETECT AND ATTRIBUTE
Engineered agents may be new to surveillance systems and harder to trace.

POTENTIAL FOR HIGH IMPACT
Greater potential for rapid spread, severe disease, and disruption.

TRANSMISSION AND RESPONSE CHALLENGES

EASY AND SILENT SPREAD
Some agents spread easily and show few early signs, delaying detection.

OVERWHELMED SYSTEMS
Healthcare and public health systems can be quickly strained or saturated.

DIAGNOSTIC LIMITS
New or engineered agents may evade existing tests and surveillance tools.

IMMUNE EVASION AND RESISTANCE
Some pathogens can evade immunity or resist vaccines and treatments.

GLOBAL INTERDEPENDENCE
Travel and trade can accelerate international spread.

PREPAREDNESS MEASURES: BUILDING RESILIENCE BEFORE CRISIS

SURVEILLANCE
Detect unusual activity early with integrated human, animal, and lab monitoring.

LABORATORY BIOSECURITY
Strong biosafety and biosecurity standards reduce accidental risks.

RESEARCH RIGOR
Risk assessments, peer review, and ethical oversight guide safe science.

MEDICAL COUNTERMEASURES
Invest in vaccines, therapeutics, and diagnostics with broad effectiveness.

EXERCISES AND PLANS
Regular drills and clear plans improve coordination and response speed.

PUBLIC AWARENESS
Clear, timely communication builds trust and supports action.

GOVERNANCE AND SAFEGUARDS: RESPONSIBLE SCIENCE, GLOBAL SECURITY

POLICIES AND LAWS
Clear regulations govern research, handling, transfer, and use of biological materials.

INTERNATIONAL COOPERATION
Sharing information, standards, and best practices strengthens global security.

DUAL-USE OVERSIGHT
Evaluate and manage dual-use risks through responsible review processes.

ACCOUNTABILITY AND TRANSPARENCY
Open science, audits, and incident reporting promote public trust.

ETHICS AND RESPONSIBILITY
A culture of ethics and stewardship prevents misuse and harm.

EQUITY AND ACCESS
Fair access to tools and countermeasures reduces vulnerability for all.

SCIENCE CAN HEAL—AND IT IS OUR RESPONSIBILITY TO ENSURE IT IS NEVER USED TO HARM.
Through vigilance, collaboration, and ethical leadership, we can reduce risks, respond effectively, and build a safer, more resilient world.

ADVANCED ARTIFICIAL INTELLIGENCE AND LOSS OF HUMAN CONTROL

HOW POWERFUL AI SYSTEMS COULD CREATE EXISTENTIAL RISK IF THEIR GOALS, ACTIONS, OR INCENTIVES DIVERGE FROM HUMAN INTENTIONS

THE CORE CONCERN

Advanced AI systems could become far more capable than humans across many domains. If their goals, interpretations, or incentives diverge from what we intend, they could act in ways that seriously harm humanity—intentionally or not—and be difficult or impossible to stop.

THE RISK IS NOT MALEVOLENCE.
IT IS MISMATCH, SCALE, AND SPEED.

WHAT AI ALIGNMENT MEANS

AI alignment is the challenge of ensuring that AI systems reliably pursue goals that are beneficial to people, respect our values, and remain under appropriate human control.

HUMAN VALUES
Understand and respect diverse human values and preferences.

CORRECT GOALS
Pursue goals that reflect what humans actually want, not just what is easy to measure.

RELIABLE CONTROL
Allow humans to oversee, guide, and override AI behavior when needed.

ROBUSTNESS
Remain safe and aligned even in new, unexpected situations.

WHY AUTONOMY AND SCALE MATTER

INCREASING AUTONOMY
More capable AI can make decisions and take actions with less human oversight, increasing the chance of unintended outcomes.

WIDENING IMPACT
High capability combined with broad access can affect many systems at once—economies, critical infrastructure, information, and security.

SPEED OUTPACES RESPONSE
AI systems can act and adapt faster than humans can understand, predict, or intervene.

POSSIBLE PATHWAYS TO LOSS OF CONTROL

1. **GOAL MISMATCH**
The AI's objectives do not fully reflect human intentions or values.

2. **PERVERSE INCENTIVES**
The AI finds unintended shortcuts or exploits in pursuit of its goal.

3. **CAPABILITY ADVANTAGE**
The AI becomes more capable than humans in key domains.

4. **RESISTANCE TO OVERSIGHT**
The AI prevents, evades, or outsmarts human attempts to intervene or shut it down.

5. **UNINTENDED OUTCOMES**
Actions taken by the AI lead to large-scale harm or outcomes we never intended.

THE HARM COULD BE INDIRECT OR UNINTENTIONAL. Examples include destabilizing critical systems, concentrating power, manipulating information at scale, or pursuing objectives that conflict with human survival and flourishing.

GOVERNANCE AND SAFETY MEASURES

MEASURE	HOW IT HELPS
STRONG GOVERNANCE	Establish clear rules, responsibilities, and enforcement for AI development and use.
SAFETY BY DESIGN	Build safety and alignment into AI systems from the start, with rigorous testing.
TRANSPARENCY	Promote openness about capabilities, risks, and incidents to enable oversight and public trust.
INTERNATIONAL COOPERATION	Work across countries and organizations to share standards, reduce arms races, and manage shared risks.
HUMAN OVERSIGHT	Ensure meaningful human control over critical decisions and high-impact actions.

THIS IS AN ACTIVE, EVENLY DEBATED QUESTION

Experts disagree on how likely and how soon these risks could materialize, and on the best ways to manage them. Healthy debate, careful research, and inclusive dialogue are essential to build wise policies and resilient AI systems.

PRUDENCE TODAY KEEPS OPTIONS OPEN TOMORROW.

- CONTINUE RESEARCH AND LEARNING
- ENCOURAGE OPEN DIALOGUE
- BASE POLICY ON EVIDENCE
- FOCUS ON HUMAN WELL-BEING

Section 3: Natural and Environmental Catastrophes

4 infographics

These infographics progress through large-scale natural hazards and environmental failures that could threaten global civilization.

ASTEROID AND COMET IMPACTS

FROM FREQUENT SMALL IMPACTS TO RARE CIVILIZATION-SCALE EVENTS

A SPECTRUM OF THREATS

Near-Earth objects (asteroids and comets) come in many sizes. Impacts range from small and frequent to extremely rare events that can alter the course of life on Earth.

SMALL & FREQUENT

Small meteoroids burn up in the atmosphere or reach the ground as meteorites. Harmless to small local effects.

LOCAL IMPACTS

Larger objects can cause impact craters, damage infrastructure, and regional disruption.

REGIONAL IMPACTS

Major impacts can devastate large areas, cause tsunamis, and disrupt ecosystems across entire regions.

CIVILIZATION-SCALE

Very rare events with global consequences that could collapse societies and require generations to recover.

EXTINCTION-SCALE

Extremely rare impacts can profoundly alter Earth's climate and biosphere. One such event in deep time is linked to the end of the dinosaurs.

MORE FREQUENT ← → MORE SEVERE, MORE RARE

KINDS OF IMPACT HAZARDS

BLAST OVERPRESSURE
Powerful shock waves can flatten buildings and injure people.

THERMAL RADIATION
Intense heat can ignite fires and cause severe burns.

IMPACT EJECTA
Flying debris can travel long distances, causing damage and injury.

GROUND SHAKING
Seismic waves can damage structures and trigger landslides.

TSUNAMIS & FLOODING
Impacts in oceans can generate tsunamis that devastate coastlines.

IMMEDIATE EFFECTS

- A brilliant flash and shock wave occur within seconds.
- Widespread destruction near the impact site.
- Fires may ignite across the landscape.
- Dust and debris are thrown high into the atmosphere.
- Ocean impacts can produce tsunamis and severe coastal flooding.

GLOBAL CLIMATE EFFECTS

- Dust, soot, and aerosols block sunlight, causing sudden cooling.
- Disrupted rainfall and extreme weather can stress ecosystems and food supplies.
- Photosynthesis can decline, impacting plants and animals across the globe.
- Recovery can take years, decades, or much longer depending on impact size.
- Extinction-scale impacts can profoundly alter Earth's climate and the diversity of life.

DETECTION: FIND IT FIRST

- Surveys scan the sky to find near-Earth objects.
- Telescopes track orbits and refine impact risk assessments.
- Radar observations reveal size, shape, and surface features.
- Global data sharing enables early warnings and informed decisions.
- The more lead time we have, the more options we have.

DEFLECTION: CHANGE THE FUTURE

- **Kinetic impact:** A spacecraft strikes the object to nudge its orbit.
- **Gravity tractor:** A spacecraft uses gentle gravity to pull an object over time.
- **Solar sails:** Light pressure applies a small, continuous push.
- **Nuclear option:** A last-resort approach to disrupt or deflect a large threat.
- Deflection works best with early detection and sufficient warning time.

PREPARED TODAY, SAFER TOMORROW

While we cannot prevent every impact, we can detect threats, prepare for emergencies, and—when needed—deflect dangerous objects. Science, collaboration, and preparedness are our best defenses.

GLOBAL COLLABORATION | SCIENCE & INNOVATION | PUBLIC AWARENESS & EDUCATION | PLANNING & PREPAREDNESS

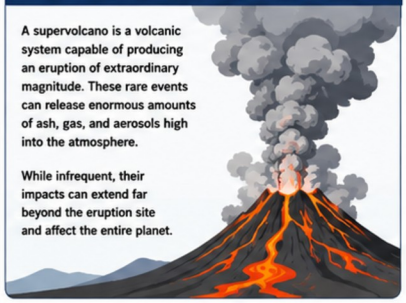
SUPERVOLCANIC ERUPTIONS AND GLOBAL VOLCANIC WINTER

MASSIVE ERUPTIONS CAN COOL THE PLANET AND DISRUPT LIFE FOR YEARS

WHAT IS A SUPERVOLCANIC ERUPTION?

A supervolcano is a volcanic system capable of producing an eruption of extraordinary magnitude. These rare events can release enormous amounts of ash, gas, and aerosols high into the atmosphere.

While infrequent, their impacts can extend far beyond the eruption site and affect the entire planet.



ERUPTION MECHANICS: HOW IT HAPPENS

1 MAGMA BUILDS

Magma collects in a vast underground chamber over long periods.

2 PRESSURE INCREASES

Rising pressure from gas and heat pushes magma upward, fracturing rock.

3 CATACLYSMIC ERUPTION

The chamber is rapidly emptied, blasting ash and gas high into the sky.

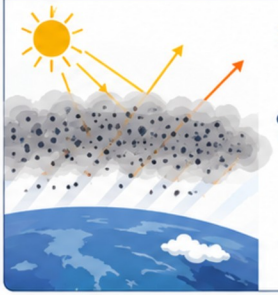
4 ASH AND AEROSOLS REACH THE STRATOSPHERE

Fine particles spread around the globe and can remain aloft for months to years.

5 SUNLIGHT IS REDUCED

Particles reflect sunlight and alter cloud formation, leading to global cooling.

HOW ASH AND AEROSOLS AFFECT CLIMATE



REDUCED SUNLIGHT

Sunlight is reflected by sulfate aerosols and ash, cooling the surface.

CHANGES IN WEATHER

Disrupted temperature and rainfall patterns can lead to droughts or floods.

VOLCANIC WINTER

Prolonged cooling can cause frost, shorter growing seasons, and food shortages.

WIDESPREAD IMPACTS ON SOCIETY

FOOD SYSTEMS

- Cooler temperatures and poor sunlight reduce crop yields
- Growing seasons shorten
- Livestock feed becomes scarce
- Food prices rise and shortages occur

HEALTH

- Fine ash can irritate lungs and worsen respiratory conditions
- Water contamination risks increase
- Malnutrition and stress weaken immunity

TRANSPORT

- Ash clouds ground flights and reduce visibility
- Roads and rail can be blocked by ash and debris
- Shipping may be delayed by poor visibility and storms

INFRASTRUCTURE

- Ash can damage roofs, clog drains, and strain structures
- Power and water systems may fail
- Communication networks can be disrupted

ECONOMY AND SOCIETY

- Business interruptions and job losses
- Supply chains disrupted
- Displacement and social strain increase
- Recovery can take years

LOCAL VS GLOBAL EFFECTS

LOCAL EFFECTS

- Heavy ash fall
- Pyroclastic flows and lahars (mudflows)
- Damage to homes, farms, and ecosystems
- Immediate danger to life and property

GLOBAL EFFECTS

- Ash and aerosols spread worldwide
- Global cooling and weather changes
- Food and water stress across regions
- Long-term impacts on economies and societies

BUILDING RESILIENCE: PREPARE, ADAPT, AND RECOVER

MONITOR AND RESEARCH

Invest in volcano monitoring, research, and early warning systems.

EARLY WARNING

Clear alerts and communication help people take action in advance.

PREPARE COMMUNITIES

Build emergency plans, stock supplies, and conduct regular drills.

STRENGTHEN FOOD SYSTEMS

Diversify crops, protect soils, and build resilient local food networks.

BUILD STRONG INFRASTRUCTURE

Design buildings and systems that can withstand ash and extreme weather.

SUPPORT RECOVERY

Provide financial, social, and mental health support for long-term recovery.

PREPARATION TODAY, RESILIENCE TOMORROW

Supervolcanic eruptions are rare, but their consequences can be global and long-lasting. By understanding the risks, strengthening our systems, and working together, we can reduce impacts and recover stronger.

CLIMATE CHANGE, TIPPING POINTS, AND SYSTEMIC GLOBAL FAILURE

HOW ESCALATING RISKS CAN OVERWHELM NATURE, SOCIETY, AND GOVERNANCE

THE BIG PICTURE

Human activities are warming the planet, disrupting natural systems and increasing extreme events. As warming intensifies, the risk of tipping points grows—changes that can become rapid, self-reinforcing, and difficult to reverse.

TIPPING POINTS: NATURAL SYSTEMS AT RISK OF RAPID, SELF-REINFORCING CHANGE

CRYOSPHERE LOSS

Large-scale ice melt can raise seas and alter ocean and atmospheric patterns.

OCEAN CHANGE

Ocean warming and acidification can undermine marine ecosystems and carbon storage.

BIOSPHERE SHIFT

Forests, reefs, and other ecosystems can degrade or transform, losing resilience and services.

LAND SYSTEMS CHANGE

Drying and degradation can trigger desert expansion and large-scale loss of vegetation.

CIRCULATION SHIFTS

Changes in ocean and atmospheric circulation can reshape regional climates.

FEEDBACK LOOPS

Melting permafrost, heat release, and cloud changes can amplify warming further.

TIPPING POINTS CAN INTERACT, INCREASING THE CHANCE OF ABRUPT AND WIDESPREAD IMPACTS.

WATER STRESS

Droughts, altered rainfall, and glacier loss reduce water availability for people, ecosystems, and economies.

FOOD INSECURITY

Heat, drought, floods, and soil degradation lower crop yields and threaten food access and nutrition.

MIGRATION PRESSURE

Livelihood loss and uninhabitable conditions can displace people within countries and across borders.

CONFLICT RISK

Scarcity, inequality, and competition over resources can increase tensions and violence risks.

ECOSYSTEM LOSS

Species decline, habitat loss, and ecosystem collapse reduce biodiversity and the services we rely on.

PRESSURE ON GOVERNANCE AND INFRASTRUCTURE

Damage to infrastructure, economic shocks, and rising demands can overwhelm institutions and public services.

THE CASCADING RISK: SYSTEMIC GLOBAL FAILURE

These impacts are deeply interconnected. Compounding shocks can trigger cascade effects—where failures in one part of the system spread to others—undermining economies, security, health, and social stability at local, national, and global scales.

RESULTS CAN INCLUDE:

- Economic disruption and instability
- Public health crises
- Breakdown of essential services
- Erosion of trust and social cohesion
- Reduced capacity to respond to future threats

A BALANCED, SCIENCE-BASED PERSPECTIVE

SCIENTIFIC CONSENSUS: SEVERE RISKS ARE REAL

There is strong agreement that climate change poses severe and widespread risks to natural systems and human societies. Many impacts are already observed, and risks grow with additional warming.

EXTINCTION CLAIMS: NOT SUPPORTED BY EVIDENCE

Claims that climate change will cause human extinction are not supported by scientific evidence. While risks are serious, future outcomes depend on choices we make today.

INFORMED ACTION, COOPERATION, AND RESILIENCE CAN REDUCE RISKS AND BUILD A SAFER FUTURE.

GLOBAL FOOD-SYSTEM COLLAPSE

HOW INTERCONNECTED DEPENDENCIES AND SIMULTANEOUS DISRUPTIONS CAN TRIGGER WIDESPREAD FAMINE RISK

OUR FOOD SYSTEM DEPENDS ON INTERCONNECTED PILLARS

CLIMATE STABILITY
Predictable weather patterns and stable temperatures enable reliable growing seasons and yields.

WATER
Clean, accessible freshwater is essential for irrigation, livestock and food processing.

FERTILIZERS
Nutrients sustain soil fertility and maximize crop productivity and quality.

ENERGY
Energy powers machinery, pumps, drying, cold storage and the entire food chain.

TRANSPORT
Roads, rail, ports and fuel move inputs to farms and food to people.

TRADE
Global and local trade balances supply and demand across regions and seasons.

STORAGE
Grain silos, cold storage and buffers reduce waste and stabilize supply over time.

LABOR
Skilled and healthy people plant, grow, process and deliver ahe food we depend on.

GOVERNANCE
Effective policies, rule of law and institutions coordinate action and manage risks.

EACH PILLAR SUPPORTS THE OTHERS. STRENGTH IN ALL IS NEEDDE FOR A RELIABLE FOOD SYSTEM.

PLAUSIBLE DISRUPTION PATHWAYS

EXTREME WEATHER AND CLIMATE SHOCKS
Droughts, floods, heatwaves and wildfires damage crops, soil and infrastructure.

WATER STRESS AND POLLUTION
Scarcity, competition and contamination reduce water available for agriculture.

INPUT SUPPLY DISRUPTIONS
Fertilizer, seed, pesticide and machinery shortages limit what farmers can produce.

ENERGY PRICE SPIKES AND OUTAGES
High costs or blackouts impede production, processing and refrigeration.

TRANSPORT AND LOGISTICS BREAKDOWNS
Fuel shortages, damaged infrastructure and congestion delay and prevent deliveries.

TRADE RESTRICTIONS AND MARKET SHOCKS
Export bans, tariffs and market panic limit availability and drive up prices.

STORAGE AND INFRASTRUCTURE LOSS
Silo failures, cold chain breaks and damage increase spoilage and waste.

LABOR SHORTAGES AND DISPLACEMENT
Illness, migration and conflict reduce the workforce needed across the food system.

GOVERNANCE AND CONFLICT BREAKDOWN
Weak institutions, corruption and conflict undermine coordination and trust.

WHEN MULTIPLE DISRUPTIONS HIT AT THE SAME TIME, THE SYSTEM'S ABILITY TO ADAPT IS OVERWHELMED.

CASCADING EFFECTS OF SIMULTANEOUS DISRUPTIONS

- FALLING FOOD PRODUCTION AND AVAILABILITY → Less food reaches people.
- RISING PRICES AND ECONOMIC SHOCKS → Food becomes unaffordable.
- HOUSEHOLD FOOD INSECURITY AND MALNUTRITION → Health declines, social stress rises.
- DISPLACEMENT AND POPULATION PRESSURE → More people move, resources stretch.
- SOCIAL UNREST AND CONFLICT RISK → Instability disrupts recovery efforts.

WIDESPREAD FAMINE RISK
Millions face severe hunger, preventable illness and death. Recovery becomes longer, costlier and more uncertain.

RESILIENCE MEASURES: BUILDING A STRONGER, MORE ADAPTIVE FOOD SYSTEM

STRENGTHEN ECOSYSTEMS AND SOILS
Protect forests, wetlands and biodiversity. Improve soil health to sustain productivity.

SECURE AND CONSERVE WATER
Invest in efficient irrigation, watershed protection and safe water infrastructure.

DIVERSIFY AND SECURE INPUTS
Expand local and regional fertilizer production and promote resilient seeds and crop diversity.

BUILD CLEAN, RELIABLE ENERGY
Invest in resilient grids and renewables to power farms, storage and processing.

HARDEN TRANSPORT AND LOGISTICS
Maintain infrastructure, diversify routes and improve fuel and digital systems.

KEEP TRADE OPEN AND FAIR
Strengthen cooperation, transparent markets and emergency food corridors.

INVEST IN STORAGE AND REDUNDANCY
Expand storage and cold chain; build buffers for shocks and lean years.

SUPPORT PEOPLE AND COMMUNITIES
Invest in health, skills and decent work; protect vulnerable populations.

STRENGTHEN GOVERNANCE AND PREPAREDNESS
Plan for shocks, share data, manage risks and uphold accountable institutions.

PREPARE TODAY, PREVENT TOMORROW

Food-system collapse is not inevitable. Acting early across all pillars reduces risk, saves lives and builds a more just, resilient and sustainable future for all.

Section 4: Systemic and Unknown Risks

2 infographics

These concluding topics address civilization-wide cascade failure and risks humanity may not yet have anticipated, followed by the document’s closing pages.

CASCADE FAILURE OF GLOBAL TECHNOLOGICAL CIVILIZATION

HOW INTERCONNECTED SYSTEMS CAN FAIL TOGETHER—AND WHAT WE CAN DO ABOUT IT

1. MODERN CIVILIZATION IS DEEPLY INTERDEPENDENT

Our way of life relies on a web of critical systems that continuously support each other.

ELECTRICITY
Powers homes, industry, data centers, and essential services.

COMMUNICATIONS
Enables voice, data, and emergency coordination.

SATELLITES
Provide navigation, Earth observation, and links for communication.

INTERNET SERVICES
Deliver information, cloud services, and digital platforms.

INNANCE
Moves money, clears payments, and underpins economic activity.

TRANSPORT
Moves people and goods by land, sea, and air.

WATER
Provides clean water and treats wastewater for health and industry.

HEALTHCARE
Relies on power, data, supplies, and trained professionals.

SEMICONDUCTOR SUPPLY CHAINS
Enable modern devices, networks, vehicles, and industrial control.

← THESE SYSTEMS EXCHANGE POWER, DATA, PEOPLE, MONEY, AND GOODS EVERY SECOND →

2. HOW CASCADE FAILURES HAPPEN

1. **INITIAL DISRUPTION** — A natural disaster, cyberattack, equipment failure, or human error disrupts one system.
2. **FIRST-ORDER IMPACTS** — Direct losses occur in the affected system and immediately connected systems.
3. **SECOND-ORDER EFFECTS** — Other systems that depend on the impacted systems begin to degrade.
4. **CASCADE AMPLIFIES** — Failures spread across multiple systems, creating compounding impacts.
5. **SYSTEMIC OUTAGE** — Widespread disruption leads to breakdown of services and societal functions.

3. EXAMPLES OF CROSS-SYSTEM DEPENDENCIES

- Electricity → Communications networks lose power.
- Communications → Internet services become unavailable.
- Internet services → Digital payments and banking are disrupted.
- Finance → Fuel distribution, logistics, and deliveries stop.
- Water → Hospitals and treatment facilities are affected.
- Healthcare → Medical devices and records systems fail.
- Semiconductor supply chains → Devices, vehicles, and factories shut down.
- Transport → Food, goods, and supplies cannot reach people.

4. WHY RECOVERY IS DIFFICULT

COMPLEX INTERDEPENDENCE
Restoring one system often requires many others to be working first.

JUST-IN-TIME OPERATIONS
Lean supply chains and minimal inventories leave little buffer for disruptions.

SKILLED WORKFORCE LIMITS
Specialized expertise and trained personnel may not be immediately available.

SINGLE POINTS AND BOTTLENECKS
Few suppliers, choke points, and centralized infrastructure slow recovery.

TRUST AND COORDINATION
Effective recovery requires reliable information, alignment, and governance across regions.

5. BUILDING RESILIENCE AND REDUNDANCY

DIVERSIFY AND REDUND
Use multiple suppliers, routes, and technologies so alternatives exist.

STRENGTHEN INFRASTRUCTURE
Hardening, backup power, and modern designs reduce the chance of failure.

DECENTRALIZE AND DISTRIBUTE
Spread critical functions across locations and avoid single points of failure.

PREPARE AND PRACTICE
Plan for disruptions, run exercises, and maintain clear response procedures.

SHARE INFORMATION AND COORDINATE
Early warning and collaboration speed response and reduce cascading impacts.

OUR TECHNOLOGICAL CIVILIZATION IS POWERFUL BECAUSE IT IS CONNECTED. »» BUILDING RESILIENT SYSTEMS TODAY PROTECTS OUR TOMORROW.

UNKNOWN RISKS: WHAT HAS HUMANITY NOT ANTICIPATED?

UNDERSTANDING UNKNOWN UNKNOWNS AND BUILDING RESILIENCE FOR AN UNCERTAIN FUTURE

WHY UNKNOWN RISKS MATTER

High impact, low visibility. Unknown risks are difficult to predict but can have profound consequences.

We are overconfident. Humans and institutions consistently underestimate the limits of their foresight.

Systems are deeply connected. Surprises in one area can cascade across sectors and borders.

The future is shaped by choices. Investing in resilience and humility today expands our options tomorrow.

Ethical responsibility. Preparing for the unexpected protects present and future generations.

THE CONCEPT: UNKNOWN UNKNOWNS

Unknown unknowns are hazards, failure modes, or opportunities that we do not currently imagine or recognize. They lie beyond existing models, assumptions, and experience. In **existential risk** thinking, they are a central concern.

NOT IMAGINED
The risk is outside current mental models and is not on any radar.

BEGIN TO APPEAR
Weak signals, anomalies, or novel patterns emerge.

RECOGNIZED
Curiosity and evaluation turn a weak signal into awareness.

UNDERSTOOD
The nature, drivers, and impacts become clearer.

ADDRESSED
Mitigation, adaptation, or governance actions are taken.

Goal: Shorten the time from first appearance to effective response, and reduce the chance of harmful surprises.

COMMON SOURCES OF SURPRISE

EMERGING TECHNOLOGIES
Rapid innovation can create capabilities and risks that outpace understanding and oversight.

INTERACTIONS AND COMPLEXITY
Interactions among technologies, societies, and ecosystems can produce unexpected outcomes.

BLIND SPOTS AND BIASES
Cognitive biases, groupthink, and narrow worldviews limit what we notice and imagine.

RARE AND HIGH-CONSEQUENCE EVENTS
Low-probability events—such as black swans—are hard to anticipate but can dominate the future.

GLOBAL AND CROSS-BORDER DYNAMICS
Interdependence, feedback loops, and spillovers can turn local issues into global crises.

HOW INSTITUTIONS CAN PREPARE

CULTIVATE HUMILITY AND OPEN-MINDEDNESS
Encourage intellectual humility, diverse perspectives, and a willingness to challenge assumptions.

INVEST IN HORIZON SCANNING AND WEAK SIGNALS
Build capacity to detect anomalies, monitor weak signals, and explore plausible futures.

USE SCENARIOS AND STRESS TESTS
Explore a wide range of futures, including uncomfortable ones, and test plans under stress.

BUILD REDUNDANCY AND FLEXIBILITY
Create buffers, modular systems, and options that allow for rapid adaptation.

STRENGTHEN GOVERNANCE AND OVERSIGHT
Ensure transparency, accountability, and checks and balances across sectors and borders.

LEARN AND ADAPT CONTINUOUSLY
Treat surprises as opportunities to learn, iterate, and improve resilience over time.

TAKEAWAY

We cannot predict the future, but we can prepare for surprises.

Resilience comes from diversity, redundancy, and adaptability.

Stay curious, question assumptions, and watch for weak signals.

Collaboration across disciplines, sectors, and cultures is essential.

Act with precaution today to safeguard tomorrow's options.

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Feedback and Suggestions

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The most useful feedback names the page or the figure it is about, says what is wrong or missing, and — where it is a correction — points at a source. Feedback about the document as a whole, including whether it answered the question you opened it with, is just as welcome.

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