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Reaching Critical Will



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Nuclear War Effects and Scientific Research: Time for a 21st Century UN Study

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The recently agreed United Nations (UN) **Pact for the Future** warns, “A nuclear war would visit devastation upon all humankind.” But it has been over 30 years since “**Climatic and other Global Effects of a Nuclear War**,” the last report by the UN Secretary-General on this issue. There has been no such UN-mandated study since then, despite decades of scientific work on these issues and the great changes that have taken place in nuclear arsenals, global society, and economy.

The last UN report on nuclear war was published just before the end of the Cold War. The global stockpile of nuclear weapons and some national arsenals today are a fraction of what they were then. The Soviet Union is long gone. Global trade has tightly knitted people and places across the world together, and people, goods, and money move on a global scale. The global human population is much larger and the world is more interdependent; as globalisation, economic crises, migration, and the COVID pandemic have shown, almost everybody everywhere is in this together.

It also is worth remembering that the Intergovernmental Panel on Climate Change (IPCC) was established just before the end of the Cold War. Global policy making has benefited immeasurably from its detailed scientific assessments of the ever-deeper and more detailed state of knowledge about climate change that has accumulated over more than three decades. The global environment and ecology and their impacts on people and society are far better understood.

At a time when nuclear threats are being made, arsenals are being modernised, and arms races are underway, it is important to bring up-to-date the international community’s shared understanding of what science today has to say about the devastating effects of nuclear war. A UN-mandated expert study assessing and addressing the current knowledge of the effects of nuclear war can help enable a more fully informed and inclusive global debate on what nuclear war means in terms of the harm that would come to people and planet.

An impartial science and evidence-based benchmark for the global consequences of nuclear war would be especially important for people and countries that have not done nuclear war studies of their own, but would be innocent bystanders in any nuclear war. It also would help governments and people in nuclear-armed states better understand the nature, scale, and severity of the many human, social, and environmental harms of nuclear war, local and global, short-term as well as long-term, which may not be fully reflected in national military assessments.

Reliable international information on the effects of nuclear war also might offer decision makers a new set of public reasons for more urgently seeking policies to avert nuclear war and for justifying such shifts.

In the beginning

One of the earliest and most significant scientific efforts to understand the effects of nuclear weapons came five years before the first bombs were built, tested, and used. In a secret 1940 memo, “On the Construction of a Superbomb based on a Nuclear Chain Reaction in Uranium,” written for the British government, physicists Otto Frisch and Rudolf Peierls laid out the physical principles for building an atomic bomb and then **described** what such a bomb could do:

The blast from such an explosion would destroy life in a wide area. The size of this area is difficult to estimate, but it will probably cover the center of a big city....

Some part of the energy set free by the bomb goes to produce radioactive substances, and these will emit very powerful and dangerous radiations... Even for days after the explosion any person entering the affected area will be killed. Some of this radioactivity will be carried along with the wind and will spread the contamination; several miles downwind this may kill people.

Frisch and Peierls explained in their memo that “[o]wing to the spread of radioactive substances with the wind, the bomb could probably not be used without killing large numbers of civilians, and this may make it unsuitable as a weapon for use by this country.”

The results of the Trinity nuclear test explosion conducted as part of the US Manhattan Project and the subsequent atomic bombings of Hiroshima and Nagasaki established the basic accuracy of this assessment.

By the end of the 1940s, the United States began to investigate the possibility of even more powerful thermonuclear weapons—also dubbed “superbombs” and often called hydrogen bombs. In 1949, led by Robert Oppenheimer, the scientists of the General Advisory Committee to the US Atomic Energy Commission **reported** on the possibility of and effects of thermonuclear weapons:

It has generally been estimated that the weapon would have an explosive effect some hundreds of times that of present fission bombs. This would correspond to a damage area of the order of hundreds of square miles, to thermal radiation effects extending over a comparable area, and to very grave contamination problems....

It is clear that the use of this weapon would bring about the destruction of innumerable human lives....

Its use therefore carries much further than the atomic bomb itself the policy of exterminating civilian populations.

The General Advisory Committee declared it had “considered at great length the question of whether to pursue with high priority the development of the super bomb. No member of the Committee was willing to endorse this proposal.”

This secret report was set aside. The US Joint Chiefs of Staff asked for the development and production of hydrogen bombs. The testing of thermonuclear weapons, beginning in 1952 with the US Ivy Mike explosion in the Marshall Islands, demonstrated the accuracy of the General Advisory Committee’s preliminary understanding of their effects.

From nuclear weapons to nuclear war

The first thermonuclear weapons entered service in 1954. It soon became obvious to some in key positions that the effects of a nuclear war were beyond imagination.

In 1958, General Robert Cutler, President Eisenhower’s special assistant for national security affairs, **wrote** to the President about a recent US nuclear war game. Cutler explained this exercise “contemplated nuclear explosions in North America, Europe, Asia, and North Africa, occurring within a half-day.” Cutler observed, “The effect of any such exchange is quite incalculable” since “[n]o one knows what [this] would do [to] the weather, to crop cycles, to human reproduction, to the population of all areas

of the world (whether or not directly exposed to the detonation). It is possible that life on the planet might be extinguished.”

These examples are all of assessments that were secret at the time, and so not publicly available. Presumably, other nuclear-armed states had their own secret assessments.

The importance of developing an understanding about nuclear weapon effects and nuclear war consequences that bridges policy makers, government leaders, the public, and the international community, has become evident over time. This shared understanding makes possible shifts in nuclear policy away from arms racing, confrontation, and nuclear threats in a way that can garner public and international support. One instance came in the year after the October 1962 Cuban missile crisis, when Soviet leader Nikita Khrushchev and President John F. Kennedy separately described publicly the effects of the nuclear war that had been avoided over Cuba.

In a January 1963 speech, Khrushchev **said**:

According to the calculations of scientists the very first blow would destroy between 700 and 800 million people ... All large towns, not only in the United States and the Soviet Union--the two leading nuclear powers--but also in France, Britain, Germany, Italy, China, Japan, and many other countries would be razed to the ground and destroyed. The consequences of atomic and H-bomb war would be effective during the lives of many generations and would result in disease, death, and would cripple the human race.

In July 1963, Kennedy **warned** of the “spiraling arms race and a collision course towards war,” saying in an address to the nation calling for a nuclear test ban treaty with the Soviet Union:

A full-scale nuclear exchange, lasting less than 60 minutes, could wipe out more than 300 million Americans, Europeans, and Russians, as well as untold numbers elsewhere. And the survivors ... would envy the dead. For they would inherit a world so devastated by explosions and poisons and fire that today we cannot conceive of all its horrors.

The UN studies nuclear war

With US and Soviet leaders describing the catastrophe of nuclear war, but without details, the international community saw the value of having UN-mandated studies on the effects of nuclear war, separate from national studies and academic research published by scientists and other scholars. The UN General Assembly in 1966 **asked for** an expert study on the “effects of the possible use of nuclear weapons and on the security and economic implications for States of the acquisition and further development of these weapons”.

The **report** was published in 1967. It argued:

The enormity of the shadow which is cast over mankind by the possibility of nuclear war makes it essential that its effects be clearly and widely understood. It is not enough to know that nuclear weapons add a completely new dimension to man’s powers of destruction... unless the facts on which they are based are clearly set out, it will not be possible to realize the peril in which mankind now stands.

A decade later, another UN General Assembly **resolution**, in 1978, asked the Secretary-General, with the assistance of qualified experts, for “a comprehensive study” on nuclear weapons that included “the effects of their use”. The Secretary-General’s Foreword to the **report**, “The Comprehensive Study on

Nuclear Weapons,” published in 1981, noted “careful study and continuous assessment of nuclear-weapon problems are clearly required to assist the international community in achieving progress in this field.”

The report judged that “The existing knowledge of the effects of the use of nuclear weapons is far from complete”. It noted in particular that:

Should large numbers of nuclear weapons ever come to be used, the total effect would be much more complex than the sum of individual cases. This is in some part due to interactions of a direct and physical nature, for instance on electrical or other networks, but the most important additional uncertainties pertain to the over-all social, economic and political consequences of the sudden and widespread devastation that a nuclear war would entail.

The report also highlighted global environmental effects, noting in particular that “fallout radiation after a large nuclear war would affect the whole world (although predominantly the hemisphere in which the war was fought). The same could hold true for some other physical effects influencing the environment, such as the dispersal of nitrous oxides and dust in the atmosphere.” It concluded that “there is very little reason to believe that the political and social situation in any country would be unchanged after a large nuclear war.”

It is a remarkable coincidence that over the next few years, concerns emerged about a new environmental effect of nuclear war. The first scientific articles appeared suggesting that the smoke from large-scale fires ignited by nuclear weapon explosions over forests and cities, with combined yields of several thousand megatons, could cause lasting darkness and cooling of the Earth’s surface, a “nuclear winter”. Scientists began to study the possibility. National scientific bodies undertook their own assessments, as did governments. The US Congress held hearings in 1984 on “The Climatic, Biological, and Strategic Effects of Nuclear War” and separately on “The Consequences of Nuclear War”. Commissioned by the US Department of Defense, the National Academy of Science in 1985 published its **study** on nuclear winter. Researchers at the Soviet Union’s Academy of Sciences did their own **model** of the climatic consequences of the nuclear war.

Both Ronald Reagan and Mikhail Gorbachev cited the research on nuclear winter. Reagan **told** *The New York Times* in 1985, “a great many reputable scientists are telling us, that such a [nuclear] war could just end up in no victory for anyone because we would wipe out the earth as we know it.... What are we talking about with the whole nuclear exchange, the nuclear winter that scientists have been talking about? It’s possible.”

Gorbachev **reflected** several years later that “[m]odels made by Russian and American scientists showed that a nuclear war would result in a nuclear winter that would be extremely destructive to all life on Earth; the knowledge of that was a great stimulus to us, to people of honor and morality, to act in that situation.”

The UN General Assembly also took action, with its 1985 resolution requesting a study on “the climatic and potential physical effects of nuclear war, including nuclear winter,” noted earlier. Published in 1988, the “Study on the Climatic and Other Global Effects of Nuclear War” **found** that “a major nuclear war would entail the high risk of a global environmental disruption.... In the opinion of the Group, residual scientific uncertainties are unlikely to invalidate this conclusion.”

It also noted, “The socio-economic consequences in a world intimately interconnected economically, socially and environmentally would be grave. The functions of production, distribution and consumption in existing socio-economic systems would be completely disrupted.”

The report proposed, “The possibility exists that further global environmental consequences of a major nuclear exchange may yet be identified.” The Group working on the report argued “the co-operative, international scientific effort that has identified this new dimension of nuclear warfare should be continued to refine present findings and to explore new possibilities.”

The end of the Cold War and collapse of the Soviet Union took away the impetus for continuing the “co-operative, international scientific effort” to improve our understanding of nuclear war advocated in the 1988 UN report.

A 21st century understanding of nuclear war effects

In the 35 years since the UN “Study on the Climatic and Other Global Effects of Nuclear War,” there have been tremendous advances in climate modeling and other areas of research that have been applied to understanding the dynamics and impacts of nuclear winter. One finding has been that nuclear winter effects could result from a nuclear war with many fewer weapons and of much lower yield than had been considered in the US-Soviet nuclear war scenarios studied in the 1980s. Work over the past three decades on nuclear war and nuclear weapon effects was presented at the **Conferences on the Humanitarian Impact of Nuclear Weapons** held in Oslo (March 2013), Nayarit (February 2014), and Vienna (December 2014).

Princeton University’s Program on Science and Global Security launched an effort that began in 2014 to have the US Congress ask for a new study on nuclear winter by the US National Academy of Sciences—the first since the 1980s. A parallel effort began in 2015 to launch a process to seek a UN General Assembly resolution for a UN study on the effects and humanitarian impacts of nuclear war.

In 2020, the US Congress agreed. It mandated the National Academy of Sciences to conduct an **“Independent Study on Potential Environmental Effects of Nuclear War”**. It was to include “potential environmental effects and socio-economic consequences that could unfold in the weeks-to-decades following nuclear wars” for “small-scale regional nuclear exchanges to large-scale exchanges between major powers”. It was to consider non-fallout “atmospheric, terrestrial, and marine effects and their consequences ... changes in climate and weather patterns, airborne particulate concentrations, stratospheric ozone, agriculture, and their impacts on ecosystems.” This study is underway.

In the meantime, new information has come to light that highlights the urgent need for independent studies of nuclear war. The US National Academy of Sciences in 2023 reported on a separate study, “Risk Analysis Methods for Nuclear War and Nuclear Terrorism” focused on how to judge threats and consequences of nuclear weapons use. It **found** that:

While much is known about the physical consequences of nuclear and radiological weapons, the indirect consequences are not as well understood. This includes the social, economic, political, infrastructure, climate, and psychological effects, which are affected by the immediate physical effects of these weapons.

It noted the nuclear war knowledge gap in the US military and policymaking process. According to this report, the Defense Threat Reduction Agency—the part of the US Department of Defense that provides the assessments of the impact of nuclear weapons—“is focused on prompt effects and military objectives. This results in a partial accounting of the consequences leading to a limited understanding of the breadth of the outcomes.” It concluded, “there is a need to improve the understanding of the physical effects of nuclear weapons (e.g., fires, damage in modern urban environments, electromagnetic pulse effects, and climatic effects, such as nuclear winter), as well as the assessment and estimation of psychological, societal, and political consequences of nuclear weapons use.”

Meanwhile, the pursuit of a new UN study has continued. In 2023, the Scientific Advisory Group of the Treaty on the Prohibition of Nuclear Weapons (TPNW) in its **report** to the Second Meeting of TPNW states recommended a new UN General Assembly mandated study on the consequences of nuclear war. It suggested a “global scientific study on the climatic, environmental, physical and social effects in the weeks to decades following nuclear war,” one that examined “whether and how the interactions of these different physical, environmental and social effects over various timescales might lead to cascading humanitarian consequences.”

More recently, in April 2024, the national science academies of the G7 countries—Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States—issued their first **statement** on nuclear weapons issues. They have been issuing joint statements on various science-related topics since 2005 to advise G7 Summit meetings.

The 2024 statement draws attention to the risks and consequences of nuclear weapon use, and summarises some of the “multifaceted damages resulting from a nuclear conflict [that] have been the object of intensive scrutiny by the scientific community in thousands of technical publications.” It includes the following observations:

A full-scale nuclear war between the nations with the largest arsenals would result in devastation to those nations and would cause harm worldwide. In addition, several recent scientific studies conclude that also nuclear wars between nations with smaller arsenals could have substantial effects beyond the early fatalities, which themselves could range up to hundreds of millions of people.

The statement also notes, “Depending on the scale of use of nuclear weapons, there is the potential for the destruction of entire ecosystems and extinction of species, due to the direct impact of explosions and fires and altered climatic conditions. In the worst cases this could be on the scale of a mass extinction.”

It also highlights that deeper and more widely-shared knowledge of the effects of nuclear war is needed. It notes in this regard that, “Among the roles of the scientific community are to continue to develop and communicate the scientific evidence base that shows the catastrophic effects of nuclear warfare on human populations and on the other species with which we share our planet.”

The United Nations should bring together scientists from around the world to develop and communicate the current knowledge of the effects of nuclear war and highlight gaps in understanding. This can help enable a more fully informed and inclusive global debate on nuclear weapons, the risks they pose, and agreement on actions to achieve the goal, reiterated recently in the Pact for the Future, of the total elimination of nuclear weapons.

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Reaching Critical Will (RCW) is the disarmament programme of the Women's International League for Peace and Freedom (WILPF), the oldest feminist peace organisation in the world.

RCW works for disarmament and the prohibition of many different weapon systems; confronting militarism and military spending; and exposing gendered aspects of the impact of weapons and disarmament processes with a feminist lens.

RCW also monitors and analyses international disarmament processes, providing primary resources, reporting, and civil society coordination at various UN-related forums.

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