FOREIGN AFFAIRS

Nuclear Must Be Part of The Solution

Reinforcing the Bargain That Strengthens Security While Expanding Peaceful Use

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Steam rising from a cooling tower of a nuclear power plant, Golfech, France, February 2024
Stephane Mahe / Reuters

A little more than 70 years ago, U.S. President Dwight Eisenhower gave his famous Atoms for Peace speech before the United Nations General Assembly. He urged the international community to use nuclear fission to improve the planet rather than to fuel more destructive wars. The United States, he pledged, would “find the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life."

At the time, there was cause for both hope and concern. When Eisenhower took to the podium on December 8, 1953, experts already understood the enormous potential of atomic science, including its ability to generate large amounts of energy and fight diseases such as cancer. But alongside this optimism was the horror caused by the use of nuclear weapons in Hiroshima and Nagasaki in 1945, and the specter of a nuclear arms race—principally between the Soviet Union and the United States—spurring the development of ever more destructive thermonuclear weapons.

In subsequent decades, the system built on the foundations of Eisenhower's vision helped drastically limit the proliferation of nuclear weapons, reduced the growth of nuclear arsenals, and supported increasing global access to the peaceful uses of nuclear science and technology, from energy production to medicine. Today, however, that system is being tested. North Korea continues its illegal nuclear weapons program, and Iran has enriched a significant amount of uranium to military grade, for which there is no logical peaceful use. Meanwhile, arms control and disarmament treaties, including the New START accord—the last remaining nuclear weapons treaty between the United States and Russia—have either collapsed or come under significant strain. There have even been open discussions about whether nuclear weapons will be used in a war in Europe, and idle threats made about their use in the Middle East, challenging the almost 40-year-old principle that "a nuclear war cannot be won and must never be fought." Amid all this, one could be forgiven for wondering how far we have in fact come on our journey, as Eisenhower put it, "out of the dark chamber of horrors into the light."

Yet even as the nonproliferation and disarmament sides of the "Atoms for Peace" equation are under threat, the third part of the bargain—the peaceful uses of nuclear science and technology for the betterment of all—holds more promise to heal the world than it has at any time since the Austrian Swedish physicist Lise Meitner and her colleagues discovered nuclear fission in 1938. It is increasingly clear that nuclear energy must be a central part of getting the world to net-zero carbon emissions. In Europe and the United States, it provides more low-carbon electricity than any other source. In China, more nuclear power plants are being built than in most of the rest of the world combined, while fast-growing economies such as India are also looking to expand their nuclear power capacity. Across Africa and other developing regions, nuclear medicine promises to help address the cancer crisis killing millions of people who lack access to lifesaving tools such as radiotherapy. And nuclear techniques are playing key roles in adapting crops and agricultural practices to the new and harsher conditions brought about by climate change.

To fulfill Eisenhower's Atoms for Peace vision, we must accelerate the pace at which the life-affirming uses of nuclear science and technology become accessible to those who need them most. Some people fear that widening the use of nuclear technology around the world increases the risk of the proliferation of nuclear weapons. The counterargument is that remedying the ongoing inequality of access will strengthen the regime that prevents the proliferation of nuclear weapons while widening support for a system that relies on buy-in from all countries—both nuclear weapons states and nonnuclear weapons states, countries that want to use nuclear energy and those that don’t.

Meitner and other scientists unlocked the awesome power of the first Greek god of the elements. In itself, that power is neither good nor bad. As the venerable late Professor David J. Rose of the Massachusetts Institute of Technology put it, “The evil lies not inherently in the phenomenon of nuclear fission or of any of the chemical elements, all of them parts of creation, but in the nature of man himself, who being given free will, can choose to build toward heaven or toward hell.” For decades after the United States and the Soviet Union abandoned their Cold War brinkmanship, we largely built toward heaven. Amid today’s challenges and opportunities, it is crucial that we redouble our resolve—both expanding access to the beneficial uses of nuclear science for all and stemming proliferation as we continue working toward a world free of nuclear weapons.

THE GRAND BARGAIN

Despite the brewing competition between Moscow and Washington, Eisenhower’s 1953 speech had a strong positive effect. His call for the creation of an agency to reduce the risk of nuclear proliferation became a reality three years later when 81 nations unanimously approved the Statute of the International Atomic Energy Agency. It also set in motion intense negotiations between the world’s two superpowers, as well as other nations, culminating in 1970 with the adoption of the Nuclear Nonproliferation Treaty. The crucial equipoise of the NPT is based on a tripartite bargain. States without nuclear weapons promise not to develop or acquire them and to submit to IAEA inspections to verify their adherence; nuclear weapons states promise in good faith to eliminate their arsenals; and those with the means to harness the peaceful uses of nuclear science and technology pledge to make them available to those that don't.

The significance of this arrangement—some call it a "grand bargain"—is difficult to overstate. The treaty is nearly universal and has been extended indefinitely. Although India, Israel, and Pakistan have not joined the treaty and North Korea announced in 2003 that it would no longer be bound by it, fewer than ten countries have nuclear weapons, compared with the dozens once feared. The nuclear arsenals of the big nuclear weapons states have shrunk considerably over the decades, and nuclear science and technology have saved millions of lives and livelihoods.

This order has had its limitations, and it is still an imperfect work in progress. But it has proved adaptable. The NPT established a safeguards system under the responsibility of the IAEA. But the strict parameters curtailing what the agency's inspectors could do allowed Iraq to pursue a clandestine nuclear weapons program in the 1990s without much fear of discovery. The Additional Protocol has since addressed this weakness and is now in force in 142 states, although some others have yet to adopt it.

Meanwhile, the original Small Quantities Protocol, introduced in 1974, minimized the burden of implementing safeguards in countries with little or no nuclear material. It did not allow the agency's inspections to verify whether a country's volume of nuclear material was indeed minimal enough for it to qualify for the protocol, however. This weakness was addressed when the protocol was updated in 2005. So far, 81 states have an operative SQP based on the revised text, leaving 18 still to make the shift.

Nuclear energy must be a central part of getting the world to net-zero carbon emissions.

Having the strongest and most adaptable safeguards system possible is essential, as is support—political and financial—for the IAEA's inspections. The increase in the overall amount of nuclear material worldwide is a reflection of its greater use for peaceful purposes, such as medicine, agriculture, construction, and science. But that increase also means that there is a lot more to inspect. In the past decade, the number of nuclear facilities and locations to inspect has risen by eight percent, and the amount of nuclear material needing to be safeguarded has grown by more than a fifth. Today, the agency's inspections are responsible for verifying the peaceful use of enough material to in theory produce more than 230,000 nuclear warheads.

Meanwhile, challenges to international peace and security underscore the importance of an impartial and strong monitoring body. North Korea's illegal nuclear weapons program continues to advance outside the nonproliferation treaty. In Iran, the IAEA has found traces of undeclared manmade uranium, and Tehran has not been forthcoming in answering many of the agency's questions. As a result, the agency cannot assure that all the activities in Iran's growing nuclear program are entirely peaceful. After the United States' withdrawal in 2018 from the Iran nuclear deal, the Joint Comprehensive Plan of Action, Iran abandoned all restraints embedded in that agreement. That means there is no longer a far-reaching, long-term system of enhanced monitoring and verification to reduce the risk of proliferation around Iran's civil nuclear program. As things stand, Iran is the only nonnuclear weapons state producing uranium at 60 percent enrichment.

Yet the actions of states allowed to have nuclear weapons under the NPT are putting undeniable stress on the order, too. Several of the world's existing stockpiles of nuclear weapons are growing, raising questions, especially among nonnuclear weapons states, about the commitment of nuclear weapons states to hold up their end of the bargain.

The NPT is essential to international security. Countries regularly weigh the costs and benefits of nuclear proliferation, and if new nuclear states were to emerge or existing ones were to create even more fearsome arsenals, more countries might feel inclined to start their own weapons programs. A mass expansion is not imminent; the treaty remains remarkably resilient. But it is notable that at the past two NPT review conferences, at which leaders of the states party to the treaty gather to take stock of its effectiveness, they were unable to agree on a joint document, mainly because of political differences not always directly related to the NPT.

As diplomats meet this month in Geneva to lay the groundwork for the review conference in 2026, the international community has a choice. It can either reinforce—through action and word—the legal framework, including the inspections process, it so painstakingly built. Or it can do nothing, allowing apathy and current political divisions to chip away at it.

ATOMS AND PEACE

The implementation of the NPT not only curbs the proliferation of nuclear weapons but also facilitates the exchange of equipment, training, and scientific information for the peaceful use of nuclear energy. The IAEA has a mandate to expand access to nuclear technology for peaceful purposes. (Most of the 178 nations that have joined the agency did so to gain precisely these benefits.) The uses of nuclear technology and science are so varied that they directly support more than half the UN's Sustainable Development Goals (and indirectly support all of them). This makes the IAEA a crucial force for sustainable economic and social development, the improvement of health systems, the mitigation of climate change and pollution, and the strengthening of energy, food and water security.

Consider the advances this system has already produced. The agency has transferred nuclear science and technology to help eradicate rinderpest, a viral disease that has killed cattle across the world; to help create over 3,400 new varieties of 210 plant species; and to map microplastics in the ocean, from Antarctica to the tropics. By widening developing countries' access to equipment and training, the agency has helped build cancer care centers in partnership with the World Health Organization, created a network of laboratories to detect and respond better to zoonotic diseases such as COVID-19 with the Food and Agriculture Organization, and developed the nuclear safety standards and nuclear security guidance on which the world depends.

Today, nuclear science can play a significant role in the fight against climate change. To help reach the goal of keeping global warming under two degrees Celsius, most analysts, including those at the Intergovernmental Panel on Climate Change and the IAEA, agree that the world will need to more than double current nuclear power capacity. Some traditional climate activists reject this premise on the grounds that nuclear power produces too much radioactive waste, presents too much of a risk of accidents, or has upfront costs that are too high. But these concerns are misplaced. No energy source is without risk. Yet nuclear power has caused fewer deaths—relative to its output—than any other source except solar energy. What is more, there simply is no substitute for what nuclear fission has proved it can accomplish at scale. Solar and wind power have made important inroads and will play a considerable role in decarbonizing energy systems, but grids that use these intermittent forms of energy still require a consistent stream of baseload power so that electricity can flow even when it is dark or the air is still.

Nuclear power does not have the problem of intermittency. That is part of the reason why it is already the source of a quarter of low-carbon power across the world. A nuclear plant built today can help displace coal and gas and will produce vast amounts of low-carbon energy for the best part of a century at a low operating cost without emitting a single particle of greenhouse gas. Nuclear power plants do not need constant refueling and can store years of supplies on site, meaning they also provide a degree of energy security and independence.

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It is true that nuclear facilities produce radioactive waste. Today's nuclear energy sector has carefully stored its byproducts and sought to minimize any impact such waste could have tens of thousands of years from now. Finland, France, and Sweden, for instance, are on their way to securely disposing of their nuclear waste deep underground.

Thankfully, policymakers, ordinary citizens, and even many influential environmental activists are beginning to understand that nuclear power is essential to decarbonization, helps stimulate economic growth, and provides improved energy security. The most recent UN climate change summit, COP28, was a pivotal moment: the world finally agreed that nuclear must be part of the transition to net-zero emissions. After decades of allowing ideology to strong-arm science, the countries that produce nuclear energy as well as those that don't agreed to include the need to invest in nuclear power alongside other low-carbon energy sources in the global "stocktake" of progress toward meeting the goals of the 2015 Paris agreement on climate change. In addition, more than 20 countries agreed to work toward tripling nuclear power capacity.

Around the world, countries are recommitting to nuclear energy or embarking on developing it. In Europe, much has been made of Germany's decision to close its last three nuclear power plants last year. But Bulgaria, the Czech Republic, France, Hungary, Romania, and the United Kingdom are significantly increasing their nuclear capacity. Other countries, such as Poland, are preparing to introduce it for the first time. Canada, China, India, the United States, and even Japan, the site of the 2011 Fukushima Daiichi accident, are refocusing on nuclear energy. Countries are restarting dormant nuclear power stations, extending the operating lives of existing plants while building new ones, and creating investment conditions for advances in technology, including in small modular reactors. Even the oil-rich United Arab Emirates has connected its first nuclear power reactors to the grid. Turkey and Egypt will soon join the list of nuclear energy-producing nations. Many of these projects are cross-border efforts, with China, France, Russia, South Korea, and the United States competing to sell their technology abroad. Some 60 reactors are under construction in 15 countries, and nearly double that number are being planned.

NOT ENOUGH

These efforts, however, are not enough. Although countries such as France and Sweden have shown how to decarbonize an electricity grid using both nuclear and hydropower, the world is only adding a quarter of the peak annual nuclear capacity that it did after the oil shocks of the 1970s. That growth is less than half the annual average that analysts say is needed to reach current climate goals. Agreeing that the world needs more nuclear power does not automatically make it happen. In its latest World Energy Investment Report, the International Energy Agency noted that of the $3 trillion to be invested in energy this year, $2 trillion is destined for clean sources overall but only $80 billion of that for nuclear power, a bit more than half of what is needed to triple capacity. Investment in unabated fossil fuel supplies—coal, oil, gas—make up the remaining $1 trillion.

Meanwhile, carbon emissions continue to reach all-time highs. Coal, the largest source of manmade carbon dioxide emissions, remains the biggest energy source for electricity generation as well as for steel and cement production. Most of the green investment is happening in advanced economies and in China, and there are big shortfalls in developing countries. To fix these trends, the world will need much larger investments in nuclear energy.

In market-driven economies, governments need to set the conditions that facilitate public and private investment in nuclear energy. Meanwhile, international financial institutions and development banks must make sure that no one is left behind. For this, they need to align their policies with science and the global imperative by removing the barriers to their vital involvement in financing nuclear power construction.

Getting to net-zero emissions will also require investment in advanced nuclear technologies—for example, reactors that can recycle spent nuclear fuel, leaving less waste, and in small modular reactors. SMRs, which are made up of prefabricated units, produce about a third of the energy of traditional nuclear power plants. By 2050, they could make up about ten percent of the world's nuclear power capacity, distributing electricity in developing countries and providing more affordable options for smaller grids, such as those operated by industries in remote locations. Governments of many developing countries are already working with the IAEA on strategies for meeting the energy needs and climate goals of their growing populations and economies. But the small reactors will not reach these markets on the required timeline without determined cross-border cooperation on regulatory approaches and greater standardization of design, efforts that the agency is currently facilitating.

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Mastering nuclear fusion is an even bigger technical challenge. While nuclear fission produces energy by splitting the atom, nuclear fusion does so by combining two light atomic nuclei to form a single heavier one—in essence, recreating the conditions inside the sun in a laboratory. This enormous experiment has been keeping scientists and engineers busy for decades.

Pessimists quip that fusion will forever be the abundant clean energy source of the future. Others say it will come, but too late. Both arguments are false. We may not yet have the full picture, but for the first time, all the pieces of the puzzle are there: the physics, the policy drivers, and the investment. And the world will not end in 2030, 2050, or 2070 just because those are the deadlines of many countries for meeting their current climate goals. We must continue to back fusion so it will be able in the not-too-distant future to produce nearly unlimited quantities of power with almost no harmful waste at all. The establishment of a worldwide fusion platform by the IAEA—working with the G-7 and other bodies, including the 35-nation fusion experiment known as ITER—is moving us closer to fusion electricity than ever before.

But the world cannot afford to think only in the long term. Climate change is already here, evident in dry fields in Africa, in floods in Central Asia, and in record heat levels across the world. Nuclear technologies and techniques can help societies adapt to climate disruptions. Isotope hydrology uses radioisotopes as tracers to analyze water flows, making it possible to better manage precious groundwater sources, for example. Physical radiation can speed up the natural process of genetic variation, creating crops better able to withstand drought and disease and thereby boost food security while reducing the use of harmful fertilizers and pesticides.

THE TRIPOD

There is no simple and direct correlation between the three parts that of the NPT bargain—nuclear disarmament, nonproliferation of nuclear weapons, and the expansion of the peaceful uses of nuclear science and technology. Yet like a tripod, all three legs are needed to provide stability—a balance that has worked very well for more than half a century. This accomplishment should not be taken for granted, especially amid today's divisive political atmosphere.

We face a convergence of challenges: climate change, energy, water and food insecurity, and the need to provide health care for all. Floods, fires, and droughts portend a disastrous future. But we have the means to avoid the worst and to adapt to new realities—with nuclear technology as a vital part of the solution. Global leaders must embrace and scale up this tool in ways commensurate with the challenges we face.

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