

# \$5.9 Trillion and Counting: The Costs and Consequences of U.S. Nuclear Weapons Since 1940

Prepared for “National Security and the New Arms Race: Impact on our Health, Environment, and Humanity”  
Des Moines, Iowa  
September 11, 2004

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NOTE: This paper is based on Stephen I. Schwartz, ed., *Atomic Audit: The Costs and Consequences of U.S. Nuclear Weapons Since 1940* (Brookings Institution Press, 1998). Further information about and excerpts from *Atomic Audit* can be found at [www.brook.edu/fp/projects/nucwcost/weapons.htm](http://www.brook.edu/fp/projects/nucwcost/weapons.htm).

Except where noted, all cost figures in this paper have been adjusted for inflation and are expressed as constant fiscal 1996 dollars. “Then-year dollars” represent the prices of goods or services current at the time they were sold. “Constant dollars” have been adjusted for the effects of inflation. Dollar costs for past expenditures are adjusted by adding inflation. This permits a comparison of expenditures over time that, although still imperfect, is less distorted than if current dollar expenditures were used, and it allows the reader to view costs in terms of the dollars approximate purchasing power at the present time. Except where noted, these adjustments have been made using standard U.S. Department of Defense (DOD) deflators.

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“The full power which resides within the American people will be evoked only through the traditional democratic process: This process requires, firstly, that sufficient information regarding the basic political, economic and military elements of the present situation be made publicly available so that an intelligent popular opinion may be formed. Having achieved a comprehension of the issues now confronting this Republic, it will then be possible for the American people and the American Government to arrive at a consensus. Out of this common view will develop a determination of the national will and a solid resolute expression of that will. The initiative in this process lies with the Government.... A large measure of sacrifice and discipline will be demanded of the American people. They will be asked to give up some of the benefits which they have come to associate with their freedoms. Nothing could be more important than that they fully understand the reasons for this.”

— *United States Objectives and Programs for National Security* (NSC 68), April 15, 1950

## Introduction

*Atomic Audit* originated with a deceptively simple question: What did the United States spend to develop and maintain its nuclear arsenal? That it took four years to answer this question is central to the story told in the book. *Atomic Audit* is the first and so far only attempt to quantify with any degree of precision the comprehensive costs borne by the United States in the pursuit of nuclear deterrence. The principal aim of the book is to document and analyze these costs in order to better understand the nature and impact of the U.S. nuclear weapons program. Along the way, we examine how and why key decisions were made, what factors influenced those decisions, and whether alternatives were considered. We utilize cost as a prism through which we were able to separate and analyze the various aspects of the overall program. The purpose of *Atomic Audit* is neither to praise all nuclear weapons programs undertaken during the Cold War nor to criticize all nuclear weapons expenditures as dangerous and wasteful. Rather, we seek to explain the process by which an arsenal consisting of but two primitive weapons in 1945 eventually grew to more than 32,000, what this process cost, and how the costs and consequences of the program were viewed by policymakers at the time.

## What Did We Spend?

From 1940-1996, the United States spent a *minimum* of \$5.5 trillion on its nuclear weapons program. The lack of data for some programs and the difficulty of segregating costs for programs that had both nuclear and conventional roles

mean that in all likelihood the actual figure is higher. This figure does not include \$320 billion in estimated future-year costs for storing and disposing of more than five decades' worth of accumulated toxic and radioactive wastes and \$20 billion for dismantling nuclear weapons systems and disposing of surplus nuclear materials. When these amounts are factored in, the total incurred costs of the U.S. nuclear weapons program exceed \$5.8 trillion.

The amount spent through 1996—\$5.5 trillion—is 29 percent of all military spending from 1940 through 1996 (\$18.7 trillion). This figure is significantly larger than any previous official or unofficial estimate of nuclear weapons expenditures, exceeding *all* other categories of government spending except non-nuclear national defense (\$13.2 trillion) and social security (\$7.9 trillion). This amounts to almost 11 percent of all government expenditures through 1996 (\$51.6 trillion). During this period, the United States spent on average nearly \$98 billion a year developing and maintaining its nuclear arsenal.

It is very difficult to comprehend figures of this magnitude. To provide some perspective, consider the following:

- ❑ \$5.8 trillion divided equally among everyone living in the United States equals a bit more than \$21,000 per person.
- ❑ \$5.8 trillion in one dollar bills stacked one atop another would stretch 459,361 miles (739,117 kilometers), to the Moon and nearly back
- ❑ If you attempted to count \$5.8 trillion at the rate of \$1 a second, it would take almost 12 days to reach \$1 million, nearly 32 years to reach \$1 billion, 31,709 years to reach \$1 trillion and thus about 184,579 years to reach \$5.8 trillion.

Of the \$5.8 trillion, just seven percent (\$409 billion) was spent on developing, testing, and building the actual bombs and warheads. To make those weapons usable by deploying them aboard aircraft, missiles, submarines, and a variety of other delivery systems consumed 56 percent of the total (\$3.2 trillion). Another \$831 billion (14 percent) was spent on command, control, communications, and intelligence systems dedicated to nuclear weapons. The United States also spent \$937 billion (16 percent) on various means of defending against nuclear attack, principally air defense, missile defense, antisubmarine warfare, and civil defense.

Enormous effort was (and is) placed on keeping nearly everything about nuclear weapons production and deployment secret—both from adversaries and the U.S. public. No one knows precisely what nuclear secrecy cost the United States in monetary terms because the government has never tracked such costs. But Department of Energy officials routinely estimate that classified programs are 20 percent more expensive than unclassified ones. Using that rule of thumb, it is possible that up to \$1 trillion of the \$5.8 trillion in actual and anticipated nuclear weapons expenditures since 1940 was spent just on keeping things secret. To avoid double counting costs, however, our estimate of tangible nuclear secrecy costs includes only the known and relatively small costs associated with processing clearances for Atomic Energy Commission and Department of Energy employees.

### What Did We Get?

Between 1945 and 1990, the United States manufactured more than 70,000 nuclear bombs and warheads in 65 different configurations, for everything from land mines and artillery shells to multi-megaton warheads to be dropped by B-52 bombers or launched atop Titan missiles. Thirty-six percent of these warheads were intended for tactical or battlefield use and nearly 12,000 warheads (17 percent) were for defensive purposes (anti-aircraft, anti-missile, and anti-submarine). To fuel these weapons, the United States produced 725 metric tons of highly-enriched uranium and 103.5 metric tons of plutonium. Uranium was produced at three separate facilities in Tennessee, Ohio, and Kentucky. Plutonium was produced in reactors at the Hanford Reservation in Washington State and at the Savannah River Plant in South Carolina.

Costs for the Manhattan Project totaled about \$21.6 billion through 1945. Sixty-three percent of this total went toward producing highly-enriched uranium at Oak Ridge, Tennessee. Another 21 percent was expended at Hanford producing plutonium.

When the megatonnage or explosive power of the U.S. arsenal peaked in 1960, it was equivalent to about 1,400,000 Hiroshima-sized bombs (the “Little Boy” bomb dropped on Hiroshima had a yield of 15 kilotons or 15,000 tons of TNT equivalent). Today’s stockpile, although significantly smaller contains the explosive equivalent of 125,000-135,000 Hiroshima-sized bombs.

From 1945 until September 1992, the United States conducted 1,030 nuclear tests (215 in the atmosphere and 815 underground). That is more tests than all the other nuclear power combined. The peak year for testing came in 1962, when 96 warheads were detonated (39 in the atmosphere) in advance of the signing of the Partial Test Ban Treaty.

During the Cold War, the United States produced nuclear weapons for 116 different delivery systems. These delivery systems included 6,125 strategic ballistic missiles (11 types), 4,700 strategic bombers (11 types), 59 strategic ballistic missile submarines (3 types), and tens of thousands of additional shorter-range missile systems, many of which were dual-capable.

Because the government did not segregate nuclear and non-nuclear costs for weapons systems capable of performing dual missions, accounting for the cost of these dual-capable systems presents a significant problem. Some 25,000 warheads and bombs—36.5 percent of all U.S. nuclear weapons—were designed to be delivered by “conventional” systems, such as Air Force and Navy tactical fighters, Army ground-based and Navy shipborne surface-to-air missiles (SAMs), Navy antisubmarine warfare systems (ASW), and Army and marine corps artillery pieces. The costs of building and operating these systems come under the heading of “General Purpose Forces” in U.S. Department of Defense account books.

*Some* portion of these costs clearly must be allocated to the cost of preparing for nuclear war, but *what* proportion? Assuming conservatively that just 15 percent of the cost of equipping, operating, and supporting general purpose forces during the Cold War was allocated to the nuclear mission comes to \$1.2 trillion. Given the extent to which nuclear weapons were integrated into the training and doctrine of U.S. general purpose forces during much of the Cold War, especially during the 1950s and 1960s, 15 percent might well be a serious underestimate of the extent to which general purpose forces were involved in nuclear missions (one analyst, writing of the Eisenhower administration’s efforts to deemphasize conventional weapons from 1953 to 1960 in favor of increase tactical nuclear capabilities, wrote, “it seems reasonable to assume that more than half the budget for general purpose forces [during this period] was nuclear-related”). Nevertheless, we chose to stick with a conservative estimate for this category of spending.

### What Did We Need?

Beyond the sheer cost of the nuclear weapons enterprise, *Atomic Audit* makes clear that the requirements for nuclear deterrence and warfighting strategies were completely subjective and inherently undefinable. When such requirements were combined with a profound lack of knowledge about the cost of the nuclear weapons program, poor intelligence about and fear of U.S. adversaries, and a blanket of secrecy that kept the public, the media, and even some policymakers in the dark, all the ingredients for a loosely bounded arms competition were present.

At one end of the deterrence spectrum, one can make an argument for achieving deterrence with just a few warheads or even with the potential to construct and deploy them (e.g., North Korea). At the other are the statements by General James Gavin, head of Army research and development, who testified before Congress in 1956 and 1957 and requested 151,000 nuclear warheads *just* for the Army (a figure justified by plans envisioning the use of as many as 423 warheads in a single day of “intense combat”), and a recently declassified report—*History of the Custody and Deployment of Nuclear Weapons*—that presents, almost as an afterthought, this sentence: “Finally, in June 1958, the [Joint Chiefs of Staff] after careful study, recommended a stockpile level of from 51,000 to 73,000 warheads by 1968.” Such figures are all the more remarkable when we consider that annual production peaked in 1960 at 7,178 warheads and that the United States only built a total of 70,000 warheads during the entire Cold War.

The co-authors of *Atomic Audit* have no special insight allowing us to ascertain precisely what number would have been sufficient. Indeed, given the subjective nature of the process, there can be no single figure. However, a number of well informed individuals have tried to quantify a minimum nuclear requirement over the years and it is worth considering the results of their efforts.

In 1957, Admiral Arleigh Burke, then the chief of naval operations, estimated that 720 warheads aboard 45 Polaris submarines were sufficient to achieve deterrence. This figure took into account the fact that some weapons would not work and that some would be destroyed in a Soviet attack (Burke felt that just 232 warheads were required to destroy the Soviet Union). At the time Burke made this estimate, the U.S. arsenal already held six times as many warheads.

Several years later, in 1960, General Maxwell Taylor, former Army chief of staff and future chairman of the Joint Chiefs of Staff, wrote that “a few hundred” missiles (armed with a few hundred warheads) was adequate to deter the Soviet Union. Yet by this time the United States had some 7,000 strategic nuclear warheads.

In 1964, Secretary of Defense Robert McNamara and his “whiz kids” calculated that 400 “equivalent megatons” (megatons weighted to take into account the varying blast effects from warheads of different yields) would be enough to achieve Mutual Assured Destruction and destroy the Soviet Union as a functioning society. At that time, the U.S. arsenal contained 17,000 equivalent megatons, or 17 *billion* tons of TNT equivalent.

### How Did This Happen?

Why did the United States spend so much money amassing an arsenal far larger than even many military experts thought necessary?

Arbitrary decisionmaking played a significant role. Although official reports and congressional testimony created the impression that military and political officials knew exactly what number of bombers or missiles would deter the Soviet Union, the reality is that the eventual size of a weapon program was arrived at through a number of interlocking factors and influences, including budget trade-offs, the perceived Soviet (and Chinese) threat, interservice and intraservice rivalry, the use of military programs to promote jobs in states and congressional districts by elected officials, corporate lobbying, cycles of technological obsolescence and development, and political charges and countercharges, to name a few. To all this must be added one additional factor: the lack of understanding—at the highest levels of government—about what these programs cost.

Fear of the Soviet Union was a significant driving force behind the U.S. nuclear weapons program. From the very beginning, U.S. officials sought to maintain a technological and numerical lead over the Soviets. The remarkable confluence of menacing events in 1949-1950—the first Soviet atomic bomb test, the communist revolution in China, the start of the Korean War, the revelations of atomic spies, and the beginning of Senator Joseph McCarthy’s anti-communist crusade—catalyzed the public and government officials and led to dire predictions about the future of the United States and global democracy. Because the United States had not yet developed means of obtaining reliable information about the Soviet Union, fear, worst-case scenarios, and mirror-imaging ruled the day (Air Force intelligence officials, for example, assumed that the Soviets would build thousands of strategic bombers because that is what the Air Force would do if the situation were reversed).

Accordingly, Congress appropriated large sums of money to expand nuclear weapons production as rapidly as possible. Congress was especially concerned because it felt that the military’s requirements for nuclear weapons were unduly constrained by the relatively small capacity of the bomb production facilities. Increased production, it was felt, would allow the creation and fulfillment of more realistic requirements. At first, however, the military was not calling for increased production. When Eisenhower entered office in 1952, production was 644 bombs a year and the arsenal contained 841 weapons in all. By the time Eisenhower left office in 1961, more than 5,100 warheads were rolling off the assembly lines annually and the arsenal held more than 22,000 weapons, the majority of which were intended for battlefield use.

As more and more money began to be appropriated for nuclear weapons, the Army, Navy, and Air Force began racing against each other to acquire new missions and develop new weapons that would place them at the forefront of U.S. military power. Weapons were developed and deployed sometimes before the rationale for their use had been fully tested in war games. Intense battles were fought over which service would control which mission (and the resulting flow of cash and prestige). For example, when the Navy introduced the Polaris submarine as an invulnerable strike platform, the Air Force tried to sink it with study after study and then created new bomber programs to try and “steal” the Polaris mission and return it to the Air Force.

The weapons laboratories at Los Alamos and Livermore also ended up competing against each other in the quest to develop newer and better nuclear weapons, with each coming to view the other as the “enemy.” Interestingly, despite a very different political and economic system, the same dynamics took hold in the Soviet Union.

Another overlooked factor is that nuclear weapons were considered “free goods” by the military services. That is, the cost of developing and building the warheads was borne entirely by the Atomic Energy Commission (now the Department of Energy). Although the AEC/DOE budget is part of the overall military budget, it has always been funded separately and in addition to monies provided to the services for weapons programs. The services had to purchase the delivery systems (except in the case of gravity bombs), but the warheads themselves cost nothing. As a result, there was little financial disincentive for service officials to request a nuclear warhead when a conventional one might be just as much or even more appropriate. Furthermore, there was little reason not to request that the AEC produce large numbers of nuclear weapons. Not surprisingly, former government officials have stated that had the military been responsible for paying for the warheads it requested, the nuclear stockpile would have been significantly smaller.

The extreme secrecy surrounding almost everything concerning nuclear weapons impeded effective democratic debate for decades. During the earliest years of the program, the AEC simply presented a budget to Congress with little or no detailed justification for how the money would be spent and why. The fundamental issue of how U.S. nuclear weapons would be used and how the requirements for deterrence were developed was never adequately explored during the early years when the basic framework for the program was being established. One result of this is that U.S. officials systematically failed to anticipate how the Soviet Union would perceive the U.S. buildup and how it would drive the Soviets to respond with its own provocative programs.

Finally, pork barrel politics (the use of government programs by elected representatives to enrich their constituents) was an important underlying factor as well. During the Cold War, military spending became a favored means of engaging in pork barrel politics because of the large amounts available within the defense budget and because funding something connected to the defense of the nation required less justification and was more immune to attack than a non-military program. Nuclear weapons programs became an important means of support for the otherwise poor and mostly rural communities where production facilities were located. In time, these communities became dependent, to varying degrees, on their local nuclear facilities, to the extent that local officials (and many workers) often downplayed the risks posed by the facilities. This dependency also made them difficult to shut down when they were no longer necessary.

When President Lyndon Johnson in 1964 decided to reduce plutonium production and end production of highly-enriched uranium (because the government had a large surplus of the material, a fact never publicly acknowledged), it took six years to complete the job, raising the anxiety level of local officials and helping to create formidable political coalitions that sought to keep the reactors at Hanford and Savannah River open. This despite the fact that Johnson had stated that the plutonium reactors should not be a “[Works Progress Administration] nuclear project, just to provide employment when our needs have been met.”

From an economic standpoint, the U.S. nuclear weapons program enjoyed a very privileged status. As a semiofficial history of the AEC/DOE production reactor program notes:

Not only was production of plutonium and tritium controlled by the government as a monopoly, but consumption was all taken by the government, a single-consumer situation that economists call a “monopsony.” This unique arrangement. . . .represented an anomaly in the American industrial world. . . .None of the operating contractors. . . .risked major capital investments in the enterprises; the contracts provided for cost reimbursement. Demand was not driven by a free or even by a regulated economic market but by the single customer’s weapons policy. . . .As a result of the Cold War and the imperatives of the nuclear standoff, this aspect of the American economy resembled the economy of the Soviet Union, in which decisions were made on a planned basis by a remote government, without reference to market forces, behind closed doors, for reasons that would not be made public.

### Environmental and Health Costs

Until the end of the Cold War, the environmental and public health costs of U.S. nuclear weapons generally received little attention and funding. This was partly because there were few systematic efforts underway to document the full extent of the problems and implement solutions. But it was also because few senior government officials felt comfortable raising concerns about real and potential hazards posed by the production and testing of nuclear weapons at a time when those weapons were still considered a crucial factor in U.S.-Soviet relations. The AEC and DOE also did what they could to discourage discussion about these issues, to the point of lying about the dangers to not only the general public but also the workers in its own facilities. As a result, one great irony of the Cold War is that although the United States produced nuclear weapons en masse to destroy the Soviet Union, and vice-versa, the principal victims of each country’s nuclear weapons were its own citizens.

From the very beginning, nuclear officials dealt with the problem of nuclear waste by devising interim rather than long-term solutions. During World War II, scientists at Hanford understood that the processing plutonium by dissolving a reactor’s fuel rods in acid created significant quantities of highly radioactive liquid wastes. They dealt with this problem by constructing giant underground tanks made of carbon steel. Carbon steel was used because stainless steel was in short supply. But using carbon steel meant having to first neutralize the acidic wastes to prevent them from dissolving the tanks and leaking out of them. This neutralization process involved adding lye and water to the wastes that among other things substantially increased their volume. The tanks were only intended as a short-term fix, but after the war no one revisited the issue. In fact, more tanks were built (this time of stainless steel) to handle the ever-increasing amount of waste generated as plutonium production increased. As a result, the wastes did leak into the ground. In fact, so much waste leaked or was deliberately dumped at Hanford that it would cover the island of Manhattan to a depth of 80 feet.

Hanford officials insisted for years that it would take centuries for the waste to reach the groundwater underneath the site. In fact, it was only a matter of decades before their optimistic assumptions were proven wrong.

A major reason why the United States today faces a “cleanup” bill of at least \$300 billion is that problems such as the Hanford waste tanks were ignored in favor of maintaining or increasing production of nuclear weapons. Production was the first priority of the government. Making sure it was done in a manner that did not unnecessarily hurt people or destroy the environment was a distant second. Had the government thought through more carefully the consequences of unrestrained production of plutonium and highly-enriched uranium, many of the problems—and bills—we face today could have been avoided or substantially mitigated. It now appears that in a number of cases, no effective “cleanup” will be possible and highly-contaminated sites will simply have to be fenced off and monitored for generations.

The human health costs of the U.S. nuclear weapons program are important but largely unquantifiable. How do you place a value on a human life? A number of the 600,000 people who worked in a nuclear weapons facility were exposed to unnecessarily high levels of radiation. Exposure to toxic chemicals was also high. At several facilities, no consistent records were kept of employee radiation exposures. At at least one, officials entered false readings into dosimetry logs. When workers fell ill and applied for worker’s compensation, the DOE spent millions of dollars on lawyer’s fees to avoid paying out even a single claim, out of fear that paying one claim would open the floodgates to lawsuits and increase calls for stricter health and safety measures, which would necessarily drive up costs and impede production of more weapons.

Uranium miners, many of the Navajo Indians, developed lung cancer after working in unvented mines without respirators or any sort of protective gear. Government officials were well aware of the dangers to the workers, but chose to ignore them to keep production high and the price of uranium low

Congress has since passed legislation providing compensation to persons harmed by nuclear weapons production and testing activities. The amount paid through early 1998--\$225 million to some 2,700 persons—while important, pales in comparison to the nearly \$2 billion paid to more than 81,000 Japanese-Americans who were illegally interned during World War II.

As bad as things were in the United States, they were even worse in the Soviet Union, where slave labor was used to mine uranium, prisoners built weapons facilities, and even the modest environmental protections in place in the United States in the 1950s and 1960s were non-existent.

### Lessons Learned

*Atomic Audit* is not just an historical exercise. The United States continues to spend some \$27 billion a year (seven percent of all military spending) to support and maintain the nuclear arsenal and at least \$18 billion on top of that for nuclear waste cleanup, missile defense programs, implementing arms control agreement and compensating victims of nuclear weapons. The Department of Energy’s stockpile stewardship program now consumes more each year (\$6.5 billion in current dollars) than the average annual expenditure during the Cold War (\$4.2 billion in current dollars) for essentially the same work (the key difference being that weapons were actually being built and tested in significant quantities). Should the next president decide to deploy national missile defenses or resume testing of nuclear weapons and production of key weapons components, these costs will rise.

The thinking underpinning the rapid increase in nuclear weapons during the 1950s was summed up in the phrase, “a bigger bang for a buck.” According to this widely accepted idea, nuclear weapons were more cost effective than conventional ones because pound for pound they could deliver more “killing power.” The thinking was that nuclear weapons would replace conventional weapons, saving large amounts of money and deterring war. But in reality nuclear weapons supplemented conventional weapons and the United States develop enormous arsenals of both, wiping out any potential savings envisioned by those who championed a large and robust nuclear arsenal. The military services also discovered by the late 1950s that early nuclear weapons, which required sizable technical support and special security measures, were actually much more expensive to deploy than anticipated. Nevertheless, the buildup continued.

Few people realize that the U.S. military historically has been the most radical advocate of nuclear disarmament. Since 1966-67, the U.S. stockpile has declined dramatically as the services eliminated the various missions and weapons they fought so hard for in the 1950s and early 1960s. Many of these decisions were made following a careful look at the benefits of the weapons versus their costs, economic and otherwise. The Army is now nuclear free, as is the Marine Corps. The Navy retired all carrier-based weapons and eliminated entirely this once central mission in 1995. All non-strategic nuclear weapons are now stored in on-shore depots. The Air Force has fewer than 100 strategic bombers and

only 550 ICBMs (and plans to cut even further once START II is implemented. Most dramatically, only about 150 tactical nuclear weapons remain in Europe, down from more than 10,000 in 1975.

The argument that nuclear weapons were the key to keeping the Cold War cold and that whatever was spent on them was therefore a sound investment is also flawed. First, nuclear weapons were not the sole means of keeping the peace (or, when necessary, fighting wars). The United States built a large conventional arsenal too, spending two and a half times more money on conventional weapons than on nuclear weapons during the Cold War. Surely these weapons played some role in how things turned out. Second, the nuclear weapons program, unbounded as it was by logic or cost, led to all sorts of weapons that contributed little or nothing to deterrence (such as the nuclear-powered aircraft; PLUTO, a nuclear-powered, nuclear-armed cruise missile; the MX racetrack scheme; and the ASTOR, an antisubmarine nuclear torpedo guided to its target by a wire, ensuring that upon detonation it would destroy not only the Soviet submarine, but also the U.S. submarine that launched it). Finally, such arguments ignore the great risks posed by the nuclear postures we maintained, postures that easily could have triggered the very war we sought to avoid.

Exactly how much of this country's \$5.5 trillion investment to date in nuclear weapons was "wasted" as a consequence of this inattention will remain a matter of debate, both because there has never been a fixed numerical goal or endpoint for deterrence and because "waste" is in the eye of the beholder. For example, many observers would classify the nuclear-powered aircraft program as a waste of \$7 billion because it never produced anything approaching a workable concept and diverted critical resources away from more urgent programs such as the development of ICBMs. But what about the more than \$1.6 billion dollars expended on Safeguard C, the 30-year effort to maintain the capability to resume atmospheric nuclear testing on short notice? Or the more than \$400 billion expended on air defense, much of it after it was ascertained that the Soviet bomber program posed no large-scale threat to the United States? What we can say is that at a minimum hundreds of billions of dollars were expended on programs which contributed little or nothing to deterrence, diverted critical resources and effort away from those that did or created long-term costs which exceeded their benefits (e.g., the overproduction of fissile materials).

Moreover, the desire to quantify precisely what was "required" for deterrence diverts attention from the fundamental point that management of nuclear policy matters violated the core principles and practices of fiscally sound democratic governance. The 1950s notion that nuclear weapons provided "a bigger bang for a buck" was simply accepted despite contemporary evidence that this assumption would not hold up to careful scrutiny. The appropriate question is not how much or how little should have been spent (to which there will never be a single, unambiguous answer), but why numerous government officials over more than 50 years failed consistently to ensure that what was spent on nuclear weapons was spent wisely and in the most efficient manner.

While it can be argued that excessive or wasteful spending is a perennial problem in the United States, and while it may be tempting to compare the nuclear weapons program to welfare or agricultural subsidies or other entitlement programs in this regard, it is important to recognize one critical difference with respect to nuclear weapons: the costs of entitlement programs are well known. They are frequently debated in Congress and are readily available in Government documents to anyone who cares to look. The costs of nuclear weapons, by contrast, have never been fully understood nor compiled by the Government. Whatever problems were encountered in managing and disbursing entitlements, they were at least well understood; indeed, the well known failures and abuses of the system have led to frequent and sustained calls to either pare back or eliminate particular programs. Notwithstanding the national security implications of nuclear weapons, in more than half a century Congress has taken action to terminate nuclear weapons programs only a handful of times and has never held a hearing, debate or vote on the cost, scale, pace or implications of the overall program even though the potential for waste, fraud and abuse is at least equal to that for entitlement programs (as evidenced by the fact that both programs consumed roughly equivalent amounts of public funding over the same period of time).

More than half a century after the advent of nuclear weapons, a decade after the fall of the Berlin Wall, and with the cold war receding into history and the future of nuclear deterrence the subject of increasing debate, the time has come to consider carefully the costs and consequences to the United States, and the world, of producing tens of thousands of nuclear weapons and basing national security on the threat of prompt nuclear annihilation. *Atomic Audit* provides what we hope will be a starting point for such an assessment, focusing on the one aspect of the endeavor, which until now has been largely ignored. As we anticipate the end of the twentieth century and the beginning of the twenty-first, we cannot rectify our mistakes or build on our achievements if our nuclear history remains incomplete and unwritten. Neither can we hope to prevent other countries from acquiring nuclear weapons if we do not fully comprehend the forces motivating our own program. Given the enormous sums expended and the substantial risks incurred, we owe it to ourselves and future generations to seek answers to these questions, to fill the gaps in the atomic ledger.