

US BOMBER FORCE:

Sized to Sustain an Asymmetric
Advantage for America



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The Mitchell Institute for Aerospace Studies

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Executive Summary

Since World War II, joint operational commanders have relied on Air Force bombers as a critical component in any combat operation involving American airpower. The nation has called on these aircraft—with their long-range, heavy payloads, and ability to penetrate enemy defenses—to deter adversaries or fly sorties during the Cold War, the Vietnam conflict, Operations Desert Storm, Allied Force, Enduring Freedom, and Iraqi Freedom, over the skies of Libya and Syria, and in numerous other operational contingencies.

As it has in the past, America's bomber force provides far more than just long-range precision strike. Currently, geographic combatant commanders' operational plans rely heavily on the bombers to perform a wide variety of missions in both permissive and heavily defended environments. The aircraft must be capable of providing precision attack, interdiction, close air support, armed overwatch, defense suppression, shows of force, anti-ship operations and minelaying, maritime surveillance, and, as always, nuclear deterrence, to name just some of their mission sets.

Despite this importance, the number of bombers in the Air Force's inventory has dwindled over time from thousands in the 1950s and 1960s to less than 100 combat-coded (i.e., available for operational missions) B-1B, B-2A, and B-52H aircraft in the current force. This decrease is due to a number of factors including changes in the strategic environment, shifts in operational approach, and resource constraints. Yet, analysis since the end of the Cold War has been remarkably consistent in establishing or validating the requirement for the Air Force to maintain 150 to 200 combat-ready bombers.

Today, the demand for bombers from the geographic combatant commanders already exceeds the number of aircraft in the force. This shortfall will increase the risk to military success, as the world becomes more dangerous and the threats grow more capable, diverse, and unpredictable. To meet these challenges, the nation will continue to depend on America's bomber force to rapidly overcome the tyranny of distance and fly from the continental United States to any location on the planet and penetrate into enemy airspace—including areas with the most advanced, integrated, and capable air defenses—to find, fix, and destroy the assigned targets.

However, it will become more challenging for the current bomber force to accomplish its missions as the number of potential adversaries grows that possess the capabilities to degrade the United States' ability to operate against them and have freedom of action in their airspace. The Defense Department recognizes this challenge and plans to recapitalize the Air Force's aging bomber force by investing in 80 to 100 new long-range strike aircraft. This plan is an important first step, but questions remain about the program. Why is there a variance of 20 percent in the Air Force's current Long-Range Strike Bomber (LRS-B) force objective?

Is this an available budget-driven number or one based on national security strategy requirements? Are 80 to 100 new bombers enough? Can the nation make do with a smaller number of new bombers, or do we need to buy more than 80 to 100 aircraft to meet the nuclear and conventional requirements of today and the future?

This paper asserts that a modernized and capable Air Force bomber force of 150 to 200 aircraft is required to maintain America's asymmetric advantage in long-range precision strike over any potential future adversary. The aging-out of the B-1 and B-52 fleets, combined with the increasingly sophisticated threat environment, drives the nation to make an immediate investment to procure a minimum of 100 new long-range strike bombers. In the long-term, to maintain the bomber force's viability, the Defense Department should consider funding additional advanced bombers beyond those 100 aircraft before the last B-1s and B-52s retire by 2045.

The goal of the cruise missiles fired and the bombs dropped by B-52s, B-1s, and B-2 stealth bombers was to make clear to the Taliban leaders and their supporters that harboring terrorists is unacceptable and carries a price.

Defense Secretary Donald H. Rumsfeld, Oct. 7, 2001

Introduction

Since World War II, America's bomber force has provided far more than just long-range strike. From that time to the present-day, operational plans have relied heavily on Air Force bombers to project power rapidly over long distances and perform a wide variety of missions in both permissive and heavily defended environments. These aircraft must be capable of conducting precision attack, interdiction, close air support, armed overwatch, defense suppression, shows of force, anti-ship operations, maritime surveillance, and, as always, nuclear deterrence, to name just some of their missions. The Mitchell Institute's report, "Beyond the 'Bomber': The New Long-Range Sensor-Shooter Aircraft and United States National Security," perhaps more accurately describes the actions performed by what were called bombers in the last century.

However, the combination of aircraft age and changes in the threat environment puts the bombers' ability to accomplish their assigned responsibilities at risk. The Air Force's bomber fleet currently includes 159 airplanes in the primary aircraft inventory (not including backup or attrition reserve assets): 76 B-52s (average age: 53 years), 63 B-1Bs (average age: 28 years), and 20 B-2s (average age: 20 years). This force yields 97 "combat-coded" aircraft that are assigned to perform operational missions. The remaining 62 bombers serve as training and test assets or are in depot undergoing periodic maintenance as well as receiving modifications or upgrades. The relatively high percentage of aircraft in maintenance status at any given time is a direct result of the airplanes' advanced age. Older aircraft cost more to operate, require a greater number of checkups, and break more often. When they do break, parts are expensive or hard to find and the aircraft take longer to fix. Additionally, the B-52s and B-1s will reach the end of their service lives by 2045, leaving only the 20 B-2s in the bomber inventory.

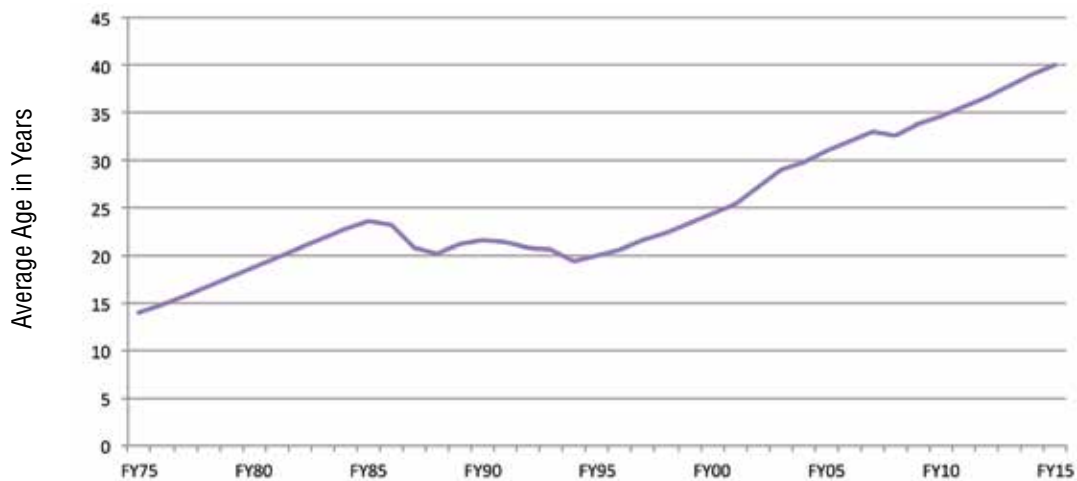


Figure 1: Average Age of US Bomber Force

Figure 1 illustrates the average age of the bomber force. The procurement of B-1s and B-2s in the 1980s and 1990s flattened the aging curve; however, since the mid-1990s, the United States has not acquired any new bombers. As a result, the average age of the force has increased annually since then. By 2025, the average age will be approximately 50 years.

While America’s bomber force grows older, enemy air defenses continue to improve at an accelerated rate. Since the 1991 Gulf War, other nations’ militaries have invested in integrating advanced technologies, networked information systems, and realistic training in order to threaten US and coalition bases and limit the operational effectiveness of friendly air and naval forces. Their advanced air defenses and offensive systems are meant to prevent or make it more difficult for the United States to project military power against these nations. Over time, it will become even more difficult for the current bomber force to meet mission requirements as the number of potential adversaries possessing these capabilities grows.

The Defense Department has recognized the challenge to maintaining the qualitative edge of America’s bomber force and, for the first time since the early 1990s, announced plans to produce 80 to 100 new Long-Range Strike Bombers (LRS-Bs). As proposed by Pentagon planners, the new bomber will serve as the central component of a future long-range-strike family of systems. The aircraft’s critical attributes in reality will make it a much more capable system compared to past or current bombers. With its extended range, large payload, and high survivability, the new bomber is actually better described as a long-range sensor-shooter (LRSS) that can deal effectively with an evolving and ever-more-challenging security environment.¹ Long range provides the ability to respond rapidly, flexibly, and globally from bases outside

¹ For a full description of the rationale behind the need for a new long-range sensor-shooter, see David A. Deptula, *Beyond the Bomber: The New Long-Range Sensor-Shooter Aircraft and United States National Security* (Washington, DC: Mitchell Institute, 2015), <https://higherlogicdownload.s3.amazonaws.com/AFA/def574d3-a429-454b-a3e8-e5073c93ca6b/UploadedImages/MI%20DD%20Bomber%20final.pdf>.

the areas threatened by an enemy and to reach deep into enemy territory at a time and place of the United States' choosing. Large payload provides the means to deliver a wide mix of weapons, both conventional and nuclear, and to maximize target coverage per sortie. High survivability and a robust sensor suite ensure the bombers are able to penetrate and successfully evade air defenses to hold an enemy's fixed and mobile high-value targets at risk. Versatility allows for adaptation to new developments, including new threats; for incorporating new technology, such as directed energy weapons, application of effects in the cyber domain, advances in electronic warfare, and kinetic weapons; and for the accommodation of expanding computer processing power and the new sensor and shooter capabilities associated with that expansion.

Recapitalizing America's bomber force is a national imperative; however, questions remain about the size of the force and the mechanism for determining how many new bombers are enough. Defining the size of the future bomber fleet is a complex endeavor. The first step is to establish a baseline by examining the force-sizing estimates developed during and after the Cold War. Interestingly, analysis since the end of the Cold War has been remarkably consistent in establishing or validating the requirement for the Air Force to build or maintain a bomber force of 150 to 200 combat-coded (i.e., available for operational missions) aircraft.

Using the historic estimates as a baseline, this paper applies quantitative techniques to analyze the range of potential sizing options for the bomber force to deal with future threat scenarios. The paper then evaluates the requirements for the bomber leg of the US nuclear triad and the implications for sizing the future bomber force.

Perspectives from the Past

The historical analysis for determining the size of the Air Force’s bomber fleet breaks down into three distinct periods: the Cold War; major regional contingencies (1991 to present); and the emerging anti-access/area-denial (A2/AD) era. Although the force-sizing approaches were different for each period, one factor remained constant: joint operational commanders have relied on the bomber force as a critical component of success in any combat operation utilizing American airpower. The nation has called on Air Force bombers—with their long-range, heavy payloads, and survivability—to deter adversaries or fly sorties during the Cold War, the Vietnam conflict, Operations Desert Storm, Allied Force, Enduring Freedom, and Iraqi Freedom, over the skies of Libya and Syria, and in numerous other operational contingencies.

A. Bomber Force Sizing in the Cold War

The detonation of bomber-delivered nuclear weapons in late 1945 against Hiroshima and Nagasaki, Japan, radically changed the calculus of war. To meet the challenges of this new era, President Harry S. Truman directed the establishment of the United States Air Force as a separate service in 1947. The new service began aggressively developing an intercontinental strike force of long-range bombers capable of delivering nuclear weapons. From World War II until the end of the 1950s, the Air Force continuously developed and fielded faster and more capable new bombers.²

Although bombers played important roles in multiple conventional conflicts during this period, the analysis for sizing the bomber force focused primarily on coverage of nuclear targets in war plans against the Soviet Union. President Dwight D. Eisenhower’s “New Look” policy relied on long-range bombers as the key component of his “Massive Retaliation” doctrine to deter Soviet aggression. By 1956, the Air Force possessed **2,450** bombers (primarily B-36 heavy bombers and B-47 medium bombers).³ At this time, the service started production of the B-52 Stratofortress. The Air Force went on to build more than **750** B-52s; the production line closed in 1962. The Stratofortress has served as the nation’s last large-scale bomber program to date. Some B-52H models are still in service today.

After the initial bomber buildup, the United States modified its nuclear force posture from bombers-only to a reliance on the triad, where intercontinental ballistic missiles (ICBMs) and submarine-launched ballistic missiles (SLBM) joined the bombers in a three-legged effort to complicate Soviet targeting and enhance US retaliatory effectiveness and survivability. Figure 2 illustrates the bomber force drawdown as ICBMs and SLBMs entered the inventory.

After the triad’s standup, analyses of bomber force size focused exclusively on nuclear target coverage and maintained a relatively constant requirement for **250** bombers, yielding approximately **200** combat-coded aircraft.

2 From 1947 to 1962, the Air Force developed or built the B-36, B-47, B-50, B-52, B-58, and B-70.

3 James C. Ruehrmund Jr. and Christopher J. Bowie, *Arsenal of Airpower: USAF Aircraft Inventory, 1950-2009* (Washington, DC: Mitchell Institute Press, November 2010).

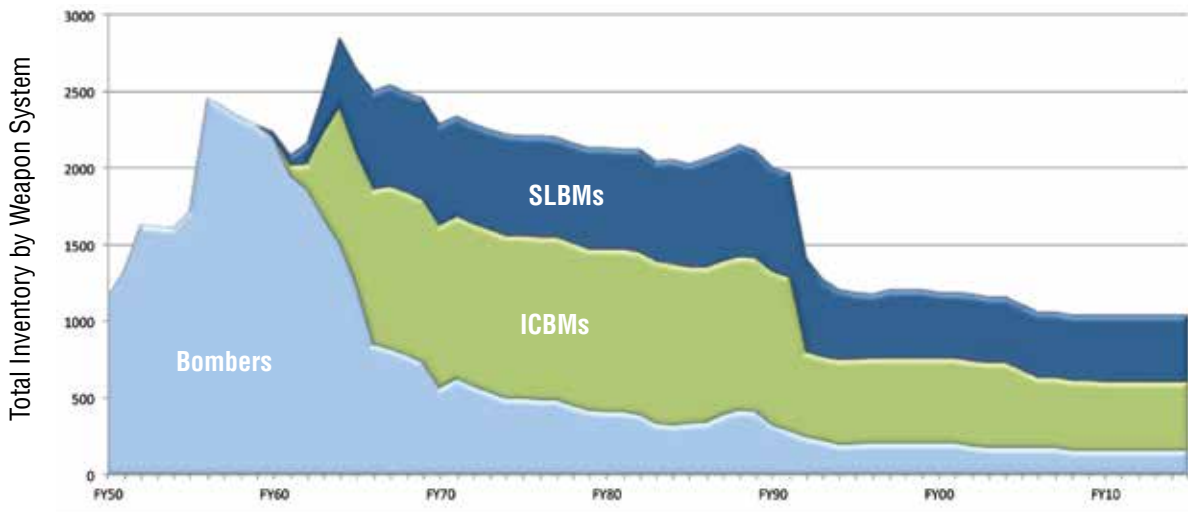


Figure 2: Triad Force Composition⁴

During the Cold War, the Air Force planned to start a number of new bomber programs to sustain a capable, credible, and survivable force of approximately **250** bombers to deter the Soviet Union. The nation required the new bombers to counter the challenge to US nuclear forces that continuous improvements in Soviet air defenses created. However, none of these new bomber programs delivered aircraft in the numbers required to replace the B-52s already in service.

The major bomber programs during this period included:

- B-70: The Air Force planned to acquire **250** B-70s.⁵ Concerns over the aircraft’s survivability, combined with developmental difficulties, rising costs, and the development of ballistic missiles, led to program termination.
- B-1A: The requirement was essentially the same as for the B-70, with **240** supersonic B-1A bombers to replace the aging B-52s.⁶ However, President James E. Carter Jr. cancelled the B-1A and elected to develop a new stealth bomber, the B-2, and cruise missiles launched from B-52s, to maintain the triad’s so-called “air-breathing” leg.
- B-1B and B-2A: The Reagan Administration made the decision to procure **100** B-1Bs as an interim bomber and **132** new stealth B-2As for a total force of **232** bombers. As then-Air Force Chief of Staff Gen. Larry D. Welch told Congress in 1990: “The original number of **132** [emphasis added] was arrived at from the **230** [emphasis added] total penetrating bombers required to give us the most efficient coverage of Soviet targets.”⁷

4 Ruehrmond and Bowie, *Arsenal of Airpower*; Federation of American Scientists, “Submarine-Launched Ballistic Missiles,” <http://fas.org/nuke/guide/usa/slbm/>; and Natural Resources Defense Council, “Table of US ICBM Forces,” <http://www.nrdc.org/nuclear/nudb/datab3.asp>.

5 Nick Kotz, *Wild Blue Yonder: Money, Politics, and the B-1 Bomber* (New York: Pantheon Books, 1988), 31.

6 Kotz, *Wild Blue Yonder*, 96.

7 United States Cong. Senate. Committee on Armed Services, *Department of Defense Authorization for Appropriations for Fiscal Year 1991*, Hearing. Part 7, 101st Congress, 2nd session (Washington, DC: GPO, 1990), 8-17.

B. Bomber Force Sizing For Major Regional Contingencies

The Soviet Union's collapse and the end of the Cold War resulted in a change from a global Soviet-centric focus to a regional strategy. This fundamental change in the threat environment drove significant reductions in force structure and funding for all the services. The new national strategy had a profound and immediate impact on the bomber force. Despite the efforts of advocates to continue the B-2 program, the Defense Department cut B-2 production from **132** aircraft to just **21**⁸ to join the remaining B-52s and the **100** B-1Bs procured in the 1980s. After the Cold War ended, the Defense Department conducted a number of sizing analyses to determine the force structure, capabilities, and posture needed to respond effectively to one or more major regional contingencies. The lessons from Operation Desert Storm in Iraq in 1991, which emphasized the importance of rapidly deployable, forward-based forces delivering massive firepower, combined with this new regional focus, affected bomber force sizing analysis as well.

Despite the changes, analysis since the end of the Cold War has been remarkably consistent in establishing or validating the requirement for the Air Force to maintain a fleet of **150** to **200** combat-coded bombers.

- **The 1992 Bomber Roadmap:** Based on Desert Storm, the Air Force developed a list of critical targets representing 1,250 aimpoints for the bomber force to strike in the first five days of conflict “to unhinge the enemy’s strategic plan, stall his offensive, and pave the way for joint forces arriving in theater.”⁹ The service assumed the bombers would play a critical role in the early phases of operations and might be required to strike adversary targets from the continental United States (which reduced daily sortie rates). The recommended force of **211** heavy bombers (B-1s, B-2s, and B-52s) yielded **166** combat-coded airplanes (**100** for conventional operations, **66** dedicated to the nuclear mission), plus an additional **24** for training and **20** for backup and testing.¹⁰ Planners estimated the conventional bomber force could destroy 24 percent of this target set in five days; with upgrades (e.g., new precision weapons), this force could strike 100 percent of the aimpoints.¹¹
- **The 1993 Bottom-Up Review (BUR):** This Defense Department-wide planning exercise used a scenario of two overlapping major regional conflicts (MRCs) to develop force structure recommendations. The BUR calculated the nation needed **100** combat-coded bombers modernized with advanced precision weapons to support *one* theater conflict.¹² According to officials in the Office of the Secretary of Defense and on the Joint Staff, that total was based on the number of bombers used in Desert Storm (60 B-52s) and military judgment that more bombers would be needed in future conflicts.¹³ Experts

8 On Feb. 23, 2008, the Air Force lost the B-2 *Spirit of Kansas* (Tail Nr. 89-0127) in a crash just after takeoff at Andersen AFB, Guam. This left 20 B-2s in the inventory.

9 Department of the Air Force, *The Bomber Roadmap: Enhancing the Nation’s Conventional Bomber Force*, June 1992.

10 Government Accounting Office, *Air Force Bombers: Options to Retire or Restructure the Force Would Reduce Planned Spending*, GAO/NSIAD-96-192, (Washington, DC: GPO, September 1996).

11 The roadmap assumed a sortie rate of 0.4 per day (flying from the continental United States) and a 75 percent mission-capable rate for the bombers.

12 Les Aspin, *The Bottom Up Review*, Office of the Secretary of Defense, 1993, 19.

13 GAO, *Air Force Bombers*, 32.

also believed the nation needed additional bombers to support the nuclear triad. The BUR, however, accepted a higher level of risk than the 1992 Air Force bomber roadmap and reduced the total number of bombers to **184** (85 B-1Bs, 20 B-2As, and 79 B-52Hs) for a combat-coded force of **158**.

- **The 1995 RAND Corp. Analysis:** The RAND Corp. study calculated the number of B-2s required to halt rapidly an armored invasion by a modern force in a distant theater. It assumed that B-52s armed with cruise missiles would provide nuclear deterrence. The study concluded the Air Force would need a minimum of **79** B-2s if an adversary massed its forces, but noted that the number of bombers required for this operation could actually triple to **237** B-2s “if a prudent adversary were to take even the simplest countermeasures such as spreading its columns and interspersing less valuable vehicles with its tanks.”¹⁴
- **The 1999 Air Force White Paper on Long-Range Bombers:** In response to congressional requests, the Air Force issued a white paper in 1999 addressing the future of the bomber force. Based on the nation’s strategy to maintain the capability to prosecute two nearly simultaneous major theater wars while deterring nuclear conflict, the white paper stated the nation required **190** total bombers to yield a combat-coded force of **130** aircraft. The report recommended continuing modernization of the force, but did not support procuring additional B-2s, noting that the Air Force would not need a new bomber until 2037.
- **The 2001 Long-Range Strike Aircraft White Paper:** After combat air operations in Serbia in 1999 and Afghanistan in 2001, then-Air Force Secretary James G. Roche directed an update of the 1999 bomber white paper. This update recommended significantly reducing the total number of bombers to **157** (60 B-1s, 21 B-2s, and 76 B-52Hs), resulting in a combat-coded inventory of **96** airplanes (36 B-1s, 16 B-2s, and 44 B-52Hs). This was similar to the quantity calculated by the 1993 BUR for conventional operations in one major conflict. The new white paper noted the Air Force would reinvest the savings resulting from bomber force reductions to make the remaining force more lethal and capable. The service also noted that new analysis indicated it would need to begin development of a new bomber in the 2012-2015 timeframe. Since then, the bomber fleet’s total aircraft inventories and combat-coded assets have remained at the levels that this white paper recommended. Most recently, both the 2010 and 2014 Quadrennial Defense Reviews (QDRs) have endorsed a combat-coded inventory of **96** bombers.

Figure 3 provides an overview on bomber force levels in the post-Cold War era. The bars illustrate the number of combat-coded bombers the United States has maintained based on the various reviews since 1992. For perspective, the Air Force’s 1992 bomber roadmap recommended **166** combat-coded bombers to support conventional operations and the nuclear deterrence mission.¹⁵

14 Glenn C. Buchan and David R. Frelinger, *Providing an Effective Bomber Force for the Future: The B-2 Debate in Perspective* (Santa Monica: RAND, May, 1995), 10.

15 In 1995, then-ACC Commander Gen John Michael “Mike” Loh testified before the House National Security Committee that 100 bombers were needed to support a regional conventional conflict, but the current force structure of 96 combat-coded aircraft was insufficient to support the nuclear deterrence mission as well. See *Hearings on National Defense Authorization Act for Fiscal Year 1996—S. 1124 (H.R. 1530)*, <https://archive.org/details/hearingsonnation21996unit>.

Starting with the BUR, the number of combat-coded bombers has dropped below the level required to support conventional operations and maintain a dedicated nuclear deterrent force. In fact, starting in 2001, the number of bombers has dropped below the requirement to support a single theater operation with a sufficient number of penetrating bombers for operational success.

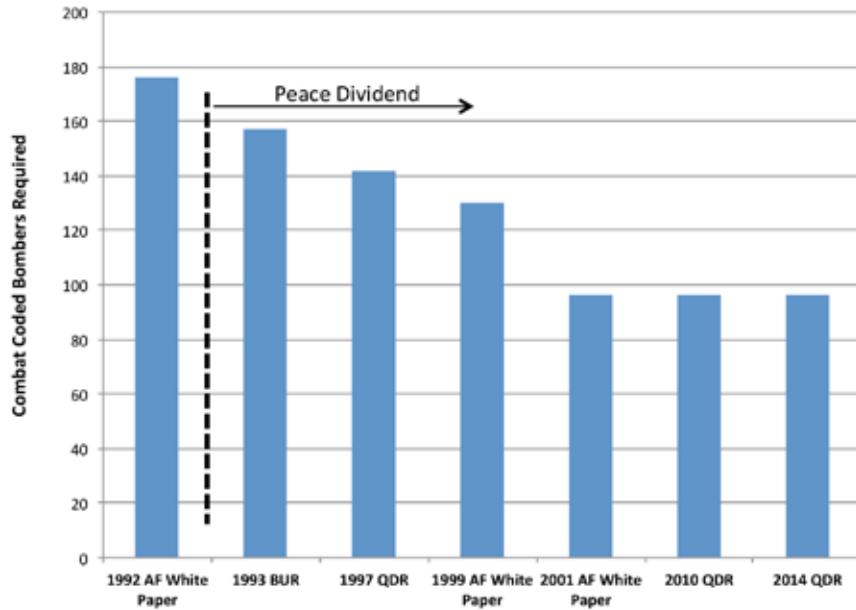


Figure 3. Historical Perspective on Combat-Coded Bomber Force Levels

Figure 4 looks forward to 2045 after LRS-B deployment. The first bar shows the range of bomber force level requirements from 2001 (96 combat-coded) to 1992 (176 combat-coded). The second bar shows the estimated total combat-coded bomber force in 2045. By then, the Air Force will have retired all B-1Bs and B-52Hs, leaving the 16 combat-coded B-2s. Assuming 85 percent of the LRS-B force is combat-coded, the bombers available for joint operations will be slightly more than **100** aircraft in 2045.¹⁶

C. The Emerging Anti-Access/Area-Denial Era

In 1999, the Air Force’s bomber white paper stated the nation would not need a new bomber until 2037. This assumption quickly proved invalid as other militaries began to take advantage of the proliferation of advanced communications, new technologies, and integrated defensive and offensive systems to erode America’s military technological superiority. Joint planners must now prepare for the day when an adversary can effectively counter US basing and access and degrade the US military’s ability to operate effectively in and over the adversary’s territory.

¹⁶ Assume slightly higher availability because the LRS-B will be a new system. As the aircraft ages, the Air Force will need to shift a greater proportion of them to test, training, and backup aircraft inventory.

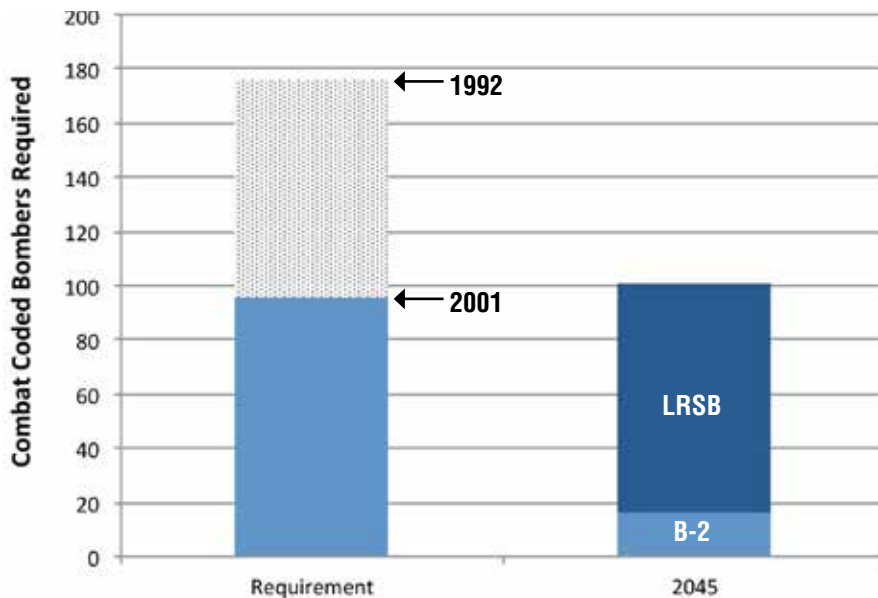


Figure 4: LRS-B and Future Force Size Requirements

As a recent report from the Center for Strategic and Budgetary Assessments, a Washington, DC-based think tank, stated, “a number of foreign militaries, including, but not limited to, those of China and Iran, have observed American military operations over the last 25 years. They are investing in networks of anti-access/area-denial (A2/AD) systems designed to challenge traditional forms of US conventional power projection in all operating domains.”¹⁷

The 2006 Quadrennial Defense Review also raised concerns over the emerging area-denial/anti-access threat and its effect on the Air Force’s aging bomber force. The review determined there was a requirement for a new penetrating bomber that would play a critical role in a joint commander’s ability to project power across intercontinental distances and conduct effective operations in a heavily defended A2/AD environment.

As a follow-on to the QDR, the Air Force conducted a Next-Generation Long-Range Strike analysis of alternatives. In May 2007, the service declared it was seeking a new manned stealthy subsonic long-range strike aircraft with a combat radius of 2,000 nm and a conventional and nuclear payload of 14,000 to 28,000 pounds.¹⁸ However, the Defense Department stopped the development until after the completion of an extensive requirements review. Once the review was completed, the Air Force in 2010 announced it would move forward with a new bomber program to acquire a planned force of **80 to 100** long-range strike aircraft.

¹⁷ Mark A. Gunzinger, *Sustaining America’s Advantage in Long Range Strike* (Washington, DC: Center for Security and Budgetary Assessments, 2010), 3.

¹⁸ Gen. Mark T. Matthews, “Return of the Bomber,” (Eaker Institute presentation at the National Press Club, Washington, DC, May 1, 2007).

Sizing the Bomber Force for the Future

The Defense Department recognized the importance of investing in 80 to 100 new long-range strike aircraft with the attributes to accomplish the assigned missions even as the number of potential adversaries increases that possess the capabilities to degrade US operational effectiveness and restrict the US military's freedom of action in their airspace. Producing a new bomber is an important first step but questions remain. Why is there a variance of 20 percent in the Air Force's current LRS-B force objective? Is this an available budget-driven number or one based on national security strategy requirements? Are 80 to 100 new bombers enough? Can the nation make do with a smaller number of new bombers, or does it need to buy more than 80 to 100 aircraft to meet the nuclear and conventional requirements of today and the future?

This paper applies three methods to determine the optimum force size for the future bomber force; a threat-based planning analysis, a regional stability estimate (similar to the US Navy's methodology for determining aircraft carrier requirements), and a nuclear deterrence assessment. Taken together, these methods paint a very clear picture not only of the importance of investing in a minimum of 100 new bombers but also the requirement, by 2045, to procure additional aircraft to maintain a viable force of approximately 200 bombers.

A. Threat Based Assessment

A threat-based assessment uses a number of assumptions concerning the threat, basing options, types of missions, and level of conflict to determine force-size requirements. As discussed previously, the Air Force employed a variant of this approach to develop its 1992 bomber roadmap and RAND used a similar method to assess B-2 force levels in a 1995 study.¹⁹

These assumptions will help show how historical experience and different threat environments provide a reasonable approximation for how many bombers the United States would need during a range of conflicts. This analysis uses the following variables: number of aimpoints, the percent of aimpoints bombers must strike, campaign length, weapons effectiveness, bomber payload, sortie rate, and attrition.

Number of Aimpoints: During a conflict, the bomber's primary mission is to strike targets. This analysis begins by identifying the number of targets struck by US airpower. Ideally, the study would use the actual target set from the classified joint campaign plan to calculate the number of aimpoints in the planning documents. However, for illustrative purposes, this analysis uses a representative set of targets and individual aimpoints associated with each target. Starting with the total number of aimpoints struck during Desert Storm (41,000),²⁰ this analysis scaled the number of aimpoints for different scenarios based

19 Glenn C. Buchan and David R. Frelinger, *Providing an Effective Bomber Force for the Future: The B-2 Debate in Perspective* (Santa Monica: RAND, May, 1995), 10.

20 *Gulf War Airpower Survey, Vol. V* (Washington, DC: GPO, 1993).

on the industrial capacity (approximated by gross domestic product) and geographic size of the country.²¹ This results in an estimate of the potential number of total aimpoints for a particular threat scenario. Using this methodology, North Korea presents nearly 74,000 aimpoints, Iran roughly 82,000, and Russia some 250,000.

Bomber Aimpoints: In every conflict involving US Air Force airpower, bombers have served as a key component of the joint force directed to strike targets. Historically, long-range bombers have delivered anywhere from 27 percent to 75 percent of the total weapons in the six major operations since World War II: Korea, Vietnam, Allied Force, Desert Storm, Enduring Freedom, and Iraqi Freedom. This analysis selects a percentage of the aimpoints that bombers need to strike based on the sophistication of the air defenses, types of targets, and the availability of theater basing. Typically, the longer the distance from airfields to the targets and the greater the threat to in-close bases result in an increased likelihood the bomber force will need to strike a larger proportion of aimpoints.

	Korea	Vietnam	Desert Storm	Allied Force	Enduring Freedom	Iraqi Freedom
Percent Munitions Delivered	27%	44%	32%	47%	66%	27%
Percent of Combat Forces (USAF, USN)	8%	8%	3%	5%	10%	7%

Table 1: Bomber Contributions to Conventional Combat Operations Since World War II²²

21 The number of aimpoints for each country includes fielded forces and fixed targets. Using Desert Storm data for Iraqi aimpoints as a baseline, the number of fielded forces for each country was scaled according to the relative size of the armed forces as reported in *The Military Balance, 2014* (London: IISS, 2014). The number of fixed aimpoints was scaled according to relative gross domestic product (purchase power parity) using constant-year dollars found at the World Bank (<http://data.worldbank.org/indicator>) and the CIA Fact Book (<https://www.cia.gov/library/publications/the-world-factbook/geos/kn.html>). For example, North Korea's armed forces are three times the size of Iraq's, yielding a fielded force size of 72,168, while its GDP is 10 percent less, resulting in 1,599 fixed aimpoints. Adding the two together yields a total of 73,768 aimpoints.

22 Robert F. Futrell, *The United States Air Force in Korea 1950-53* (USAF, 1983); *USAF Management Summary--Southeast Asia Review*, Aug. 30, 1973; "Order of Battle for Carrier Forces in Westpac/Vietnam (1964-75)"; *Gulf War Airpower Survey, Vol. V*, 1993; *Air War Over Serbia Fact Sheet, 2.; Annual Report to the President and Congress* (Washington, DC: Office of the Secretary of Defense, 2002), 118 and 140.; Benjamin S. Lambeth, NATO's Air War for Kosovo, (Santa Monica: RAND, 2001), 87; William Arkin, "Weapons Total from Afghanistan Includes Large Amount of Cannon Fire, *Defense Daily*, March 5, 2002; Lambeth, *Air Power Against Terror* (Santa Monica: RAND, 2006); US Central Air Forces, *Operation Iraqi Freedom--By The Numbers*, April 30, 2003; Thomas Withington, *B-1B Lancer Units in Combat* (Oxford: Osprey Publishing Ltd., 2006); TSgt Jason Tudor, "Air Force Forward Operating Base Scales Down After Operation," April 25, 2003, <http://www.raf-fairford.co.uk/457>; and Andrew Krepinevich, *Operation Iraqi Freedom: A First Blush Assessment*, (Washington, DC: CSBA, 2003), 26.

Campaign Length: Operational tempo is also a critical factor. The length of the overall campaign directly affects the number of targets struck per day; that, in turn, determines how many bombers are needed daily to strike these aimpoints. Although the initial phase of air operations for Desert Storm, Allied Force, Enduring Freedom, and Iraqi Freedom lasted less than 60 days, this analysis uses a range of campaign durations depending on the sophistication and capability of the adversary.

Weapons Effectiveness: Another key variable is the number of weapons delivered against each aimpoint. Historically, target destruction in relatively permissive environments required about three precision-guided weapons for every two aimpoints.²³ However, if the targets are hardened or the adversary uses countermeasures to try to defeat those weapons, then overall weapon effectiveness decreases significantly. This means that the more advanced the adversary is, the more weapons are required per target.

Bomber Payload: The number of munitions an individual aircraft carries clearly is critical to the number of bombers needed in the conflict. Assuming a payload of 20,000 pounds (which public sources identified as the Air Force's midpoint requirement for the canceled "2018 Bomber"), then each aircraft can carry anywhere from 10 to 80 air-to-ground weapons that range in size from 2,000 pounds down to 250 pounds.

If the bomber must deal with enemy air defenses, then the strike payload will decrease to make room for other types of weapons, such as self-defense missiles or decoys. This analysis assumes an average number of weapons per bomber based on the particular threat scenario. Typically, the greater the threat is, the smaller is the available strike payload.

Sortie Rate: The number of missions one aircraft can fly per day is a key factor. Mission type, maintenance turn times, and crew ratios affect sortie rates; however, distance to the target is the biggest factor. The further away the base, the lower the sortie rate. Other analysis has shown that airmen can generate about one sortie per day per bomber, for aircraft based in theater. If the threat to theater bases is too high and the bombers must fly from farther away, this rate falls to 0.6 sorties per day. Bombers launched from the United States would have an even lower rate: approximately 0.3 sorties per day.

Attrition: Any analysis must assume some level of attrition over the length of the campaign, particularly as the sophistication of the threat increases. During Linebacker operations during the Vietnam War, the North Vietnamese shot down 14 B-52s in the first 11 days, resulting in a total attrition rate of 7 percent. With the proliferation of advanced A2/AD capabilities, a loss of 10 percent over the length of the campaign is possible, though attrition that high would likely result in a reevaluation of operations and tactics. Table 2 shows representative bomber requirements based on varying the assumptions to meet a range of potential contingencies. The calculations above illustrate the number of operational bombers needed to deal with each conflict. The numbers focus on combat-coded aircraft, and the bomber force would require additional aircraft to account for depot maintenance, training, and testing.

23 CENTAF, Operation Iraqi Freedom--By the Numbers.

	Targets	% by Bombers	Campaign (Days)	Weapons per Target	Weapons per Bomber	Sortie Rate	Total Attrition (%)	# of Bombers
Korea	73,768	30	30	1.6	20	1	0	60
Iran	81,925	40	60	1.6	15	0.6	5	103
Russia	249,906	50	180	2.5	15	0.5	10	258

Table 2: Bombers Required for Contingencies

The analysis illustrates the impact of varying these assumptions on bomber force size and the ability of the United States to respond to a variety of conflict scenarios. For example, using the above assumptions and the procurement of 100 new bombers to generate 85 operational aircraft, the inventory of new bombers would not be enough to strike all the targets in a notional joint air operation against Iran.

There are additional factors the Defense Department must consider for force sizing. While the United States is engaged in one theater, there is the requirement for additional bombers to provide deterrence against aggression in another region. Every defense review since the early 1990s—to include the latest QDR of 2014—has stated a requirement for the US military simultaneously to be able to operate effectively in more than one contingency.²⁴ Another requirement is that sufficient bomber aircraft are available to conduct the nuclear deterrence mission during a period of heightened tensions brought on by a conventional conflict.

B. Regional Stability

Since Desert Storm, the Defense Department has continuously deployed forces around the world to support geographic combatant commanders' operational requirements. This constant demand and the need to maintain high levels of readiness led the Air Force to organize its combat forces into Air and Space Expeditionary Forces (AEFs). Every unit in the Air Force belongs to one of 10 AEFs with some special mission assets assigned to support multiple AEFs. Over time, the Air Force has found this is an effective and efficient construct. It maintains high levels of readiness to support sustained operations, with an added capability to “surge” additional forces when needed. It also maintains forces to assure a sufficient rotational base to sustain operations to execute the National Military Strategy.

Currently, each AEF contains one bomb squadron to ensure a long-range penetrating strike capability remains available to support nonnuclear joint operations. To generate effectively the number of bomber sorties that each AEF requires, the ideal number of aircraft per squadron is 12. This level ensures availability of the optimum number of combat-ready bombers while still allowing for force management like flightline repairs and depot maintenance.

²⁴ *Quadrennial Defense Review 2014*, VI. The document states: “If deterrence fails at any given time, US forces will be capable of defeating a regional adversary in a large-scale multi-phased campaign, and denying the objectives of—or imposing unacceptable costs on—a second aggressor in another region.”

The Air Force, therefore, needs **120** combat-coded bombers to meet current AEF requirements for conventional-only operations. An additional 25 percent of that number of aircraft is required for training, test, and evaluation (30). Added to the resulting 145 aircraft is an additional 20 percent for backup aircraft inventory and to constitute an attrition reserve.²⁵ A recent study highlighting the AEF concept demonstrates that such an approach creates a requirement for **174** bombers to meet the tenets of the current national security strategy: a number larger than the current bomber force.²⁶

C. Nuclear Deterrence

Based on the New Strategic Arms Reduction Treaty (New START) between the United States and Russia, the United States has established a minimum requirement for 60 strategic bombers to counter the nuclear threat posed primarily by Russia. Under the treaty's rules, bombers are especially valuable because each one counts as just one weapon system even though it can carry multiple nuclear weapons. The counting rules acknowledge that bombers are a stabilizing element. Thus, they provide incentive for the United States and Russia to field them rather than ICBMs or SLBMs. The United States currently plans for 42 B-52Hs armed with nuclear cruise missiles and 18 B-2As armed with nuclear gravity bombs under New START.

In addition to Russia, China has been rapidly expanding its nuclear arsenal and other states such as North Korea and Iran have nuclear ambitions. Based on these emerging threats, many experts believe the current nuclear posture of 60 dedicated nuclear bombers is the absolute minimum to assure friends and allies that the United States has the ability to extend its nuclear umbrella and protect them against a nuclear threat.²⁷

In sum, the nation requires some 60 bombers for the air-breathing leg of the triad to provide effective nuclear deterrence. However, the question remains how to factor these aircraft into total force-sizing requirements for the bomber fleet. As previously discussed, some portion of the bomber force must remain available to maintain nuclear deterrence during the heightened tensions when the United States is engaged in a conventional conflict.

Yet, if the United States procures only 100 new bombers and retains the existing force of 20 B-2s, the total bomber inventory will be 120 aircraft by 2045, with approximately 100 combat-coded bombers available for conventional and nuclear operations. In a large-scale conventional conflict, the joint force commander may need to commit the entire bomber force, as illustrated by planning for theater conflicts in the 1990s and the quantitative threat analysis for force-size requirements. If senior decision-makers determined that conditions during the conflict required putting bombers on nuclear alert, it would force the commander directing the ongoing conventional operations to reduce the number of bombers committed to that theater.

25 James Drew, "Deptula: USAF Needs 174 new bombers to replace 'geriatric' force," *Flightglobal*, Sept. 11, 2015, <https://www.flightglobal.com/news/articles/deptula-usaf-needs-174-new-bombers-to-replace-geri-416654/>.

26 Gunzinger and Deptula, *Toward a Balanced Combat Air Force*, (Washington, DC: CSBA, 2014), 18. The authors argued for a requirement of 174 bombers using the AEF construct.

27 Amy F. Woolf, *US Strategic Nuclear Forces: Background, Developments, and Issues* (CRS Report for Congress, Sept. 5, 2014), 34.

The reduction in the bombers' conventional power projection could delay progress in the theater campaign or increase risk to its overall success. All of these factors illustrate that limiting production of the new bomber, LRS-B, to 100 airframes would severely decrease the options available to national decision-makers during times of crisis or periods of instability.

The analysis affirms the necessity of maintaining a force of **200** advanced bombers, providing an operational force of **150** to **160** aircraft to give national leaders the nuclear and conventional air-breathing power-projection option to deter or defeat any foe. A modernized bomber force of **200** aircraft will sustain America's asymmetric advantage in long-range precision strike for decades to come.

Conclusion

From the Cold War to the present day, the United States has relied on the Air Force's bomber fleet to demonstrate national will, deter enemies, protect allies, and deliver decisive combat power as an integral component of any joint operation. Yet, despite this importance, the number of bombers has dwindled over time from thousands in the 1950s and 1960s to less than a hundred combat-coded B-1B, B-2A, and B-52H aircraft in the current force. Due to a number of factors, including changes in the strategic environment, shifts in operational approach, and resource constraints, the nation has never fully recapitalized its bomber force, leaving it with some of the oldest aircraft in the Air Force's inventory.

Maintaining America's asymmetric advantage in long-range precision strike over any potential future adversary requires a modernized and capable bomber force of **150 to 200** aircraft. The aging-out of the B-52 and B-1 fleets, combined with the increasingly sophisticated threat environment, drives the nation to make an immediate investment to procure a minimum of 100 new long-range strike bombers to ensure the bomber fleet can accomplish the full range of its assigned nuclear and conventional missions. In order to maintain the viability of America's bomber force over the long term, the Defense Department should also consider funding additional advanced bombers beyond those 100 aircraft before the remainder of the B-52s and B-1s retire by 2045.



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