

Understanding the B-21 Raider: America's Deterrence Bomber

Col Mark A. Gunzinger, USAF (Ret.)



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Contents

FOREWORD	1
EXECUTIVE SUMMARY	2
Why Penetrating Bombers Today?	2
Recommendations	7
INTRODUCTION: THE HOLLOWING-OUT OF AMERICA'S BOMBER FORCE	8
In This Study	10
THE CASE FOR PENETRATING BOMBERS	11
Penetrating Bombers Provide Options that are Unmatched by Other Strike Systems	11
Advantages of the B-21 as Lead Component of a Long-Range Strike Family of Systems	17
AMERICA'S DETERRENCE BOMBER	20
Defeating a Chinese <i>Fait Accompli</i> Campaign	21
A More Balanced Combat Air Force Mix is Needed	22
SIZING THE FUTURE BOMBER FORCE	24
1. The Bomber Force Must Be Sized for a Major Conflict with China	24
2. Size the Bomber Force to Credibly Deter a Second Aggressor	25
3. Another Requirement: Sizing for Nuclear Deterrence	26
Multiple Studies Have Recommended a Larger Bomber Force	27

RAPIDLY INCREASING LONG-RANGE STRIKE CAPACITY IS ALSO CRITICAL

TO DETERRENCE 29

Resource Constraints Threaten to Extend the U.S. Bomber Shortfall 30

Two Approaches for Reducing the Bomber Gap This Decade 30

Designed for Affordability: A B-21 Force Development Enabler 32

CONCLUSION AND RECOMMENDATIONS 34

Recommendations 35

Foreword

Today, the U.S. bomber force is about one-third of what it was at the end of the Cold War. Conversely, the number, complexity, and capability of the threats facing the United States have grown. If the U.S. military is going to succeed in a future major conflict, it is time to recognize the stark deficit in the U.S. Air Force's bomber capacity and the need to rectify that deficiency as soon as possible. Given that defense budgets will not likely increase significantly any time soon, the Department of Defense must shed force elements of little value in a peer fight and invest the savings to increase B-21 production.

The value of a high-payload, long-range, survivable aircraft is undeniable. However, with the collapse of the Soviet Union, there was a general ignorance of the value of bombers in a conventional role, even though studies during the Commission on Roles and Missions in 1994/1995 highlighted their value relative to other, increasingly vulnerable means of power projection in the U.S. inventory.

In this report, Mark Gunzinger assesses the need to rebuild a U.S. bomber force that has the capacity to simultaneously defeat Chinese aggression in the Indo-Pacific, credibly deter an opportunistic aggressor in another theater, and deter nuclear attacks on the United States—all requirements of the National Defense Strategy.

What he has produced is the product of a lifetime of operational experience, force planning, and an understanding of the true values and virtues of range, high payload, low observability, and the ability to rapidly close kill chains over long distances to a degree that no other force element in the U.S. military inventory can provide. Meeting this demand, he lays out five succinct recommendations that the Department of Defense should implement.

The bottom line is that the decline in the U.S. bomber force must be reversed by building sufficient numbers of B-21s to specifically meet the growing challenges of our pacing threat—China—while providing the advantage to deter and, if necessary, defeat the other threats facing us as well.

A handwritten signature in black ink, reading "David A. Deptula". The signature is stylized with a large, sweeping flourish at the end.

Lt Gen David A. Deptula, USAF (Ret.)
Dean, The Mitchell Institute for Aerospace Studies

Executive Summary

The ability to conduct long-range strikes at scale in all threat environments has been a decisive U.S. military advantage for more than 70 years. The Air Force’s long-range bombers give theater commanders the capability to strike a broad spectrum of enemy targets that would otherwise be inaccessible to U.S. and allied forces. Today, this advantage is severely diminished. Successive force cuts since the Cold War, combined with the failure to acquire more than a small, “silver bullet” inventory of stealthy bombers, means the Air Force entered 2023 with a fleet of only 141 B-52Hs, B-1Bs, and B-2s—about a third of the size of its 1989 bomber force. A force this size cannot meet the growing demand for global precision strikes, including operations in contested and highly contested environments, which are now the norm for peer conflicts. The good news is the Air Force will soon field the B-21 Raider, the world’s most advanced stealthy bomber. The continuing challenge will be to ensure the B-21 program is resourced to rapidly acquire an inventory that meets operational demands. This will require avoiding the same kind of budget-driven decisions that eroded nearly all the service’s advanced combat aircraft purchases since the Cold War, as in the case of the B-2, the F-22, and now the F-35A.

This report assesses the need to rebuild a U.S. bomber force that has the capacity to simultaneously defeat Chinese aggression in the Indo-Pacific, credibly deter an opportunistic aggressor in another theater, and deter nuclear attacks on the United States—all requirements of the *2022 National Defense Strategy* (NDS).¹ Therefore, the U.S. Air Force should develop a total force of more than 300 bombers that includes at least 225 stealthy B-21s.

Multiple independent studies completed in recent years have reinforced the need for a significantly larger bomber force.² Those questioning this recommendation should consider that bombers stand alone in possessing the range, survivability, and weapons capacity to rapidly blunt a Chinese *fait accompli* offensive to seize Taiwan or other Indo-Pacific areas critical to U.S. security interests, the Department of Defense’s (DOD) pacing threat. Any delay in rapidly fielding a new penetrating bomber in significant numbers will continue the slide toward an undersized U.S. military that will struggle to defeat Chinese aggression and meet other *National Defense Strategy* requirements. Other combat aircraft lack the B-21’s attributes, and they cannot match the increased options B-21s will provide theater commanders. Without the Raider, a viable “plan B” for these options does not exist.

Why Penetrating Bombers Today?

Threats facing the United States and its allies and partners are now far different than the more benign security environment the DOD used to justify hollowing out its bomber force and other combat aircraft inventories in the decade after the Cold War. The dissolution of DOD’s long-range strike capabilities and capacity accelerated in the post-9/11 era as it surged resources to low-intensity counterterrorism and counterinsurgency operations. The tide began to turn in the 2010s when defense leaders acknowledged China’s military build-up was a growing threat. Even then, lip service about a “rebalance to the Pacific” continued to mask its failure to take consequential steps toward rebuilding a long-range strike force and to develop other capabilities needed to address the growing threat of Chinese military aggression.³

Understanding the Consequences of Failing to Deny a *Fait Accompli*

For the purposes of this report, a Chinese *fait accompli* refers to a successful campaign by PLA forces to rapidly seize territory along the periphery of China before the U.S. military can effectively respond. A *fait accompli* invasion of Taiwan that achieves its objectives—possibly within days or a few weeks—would leave the United States with the unacceptable choice of either acquiescing to the new status quo or launching a massive counteroffensive to evict occupying forces. Importantly, such a counteroffensive would be far more costly than preventing a successful invasion in the first place, and both responses would impose devastating long-term consequences to the security of the United States and its allies and partners.

This finally changed when the *2018 National Defense Strategy* established “defeating a Chinese *fait accompli* military campaign to seize Taiwan or another area in the Indo-Pacific” as DOD’s new pacing threat for sizing and shaping America’s military.⁴ This policy shift was a long-overdue acknowledgment that the military modernization campaign China began after Operation Desert Storm had transformed its People’s Liberation Army (PLA) into a formidable adversary.⁵

The PLA’s most advanced weapons systems are now approaching and, in some instances, surpassing the U.S. military’s current capabilities. Furthermore, China has fielded offensive and defensive capabilities that are “expressly designed to keep U.S. and allied forces at arm’s length and to suppress U.S. and allied operations for a period of time that is sufficient to allow the success of a *fait accompli*.”⁶



Figure 1: PLAAF J-20 with PL-15 missiles.

Source: Photo was taken at a 2021 Chinese Airshow. See Thomas Newdick, “[A Guide To China’s Increasingly Impressive Air-To-Air Missile Inventory.](#)” *The War Zone*, September 1, 2022.

These capabilities comprise an anti-access/area-denial (A2/AD) complex for China that includes multiple variants of low-observable military aircraft like the J-20; the PL-15, a long-range air-to-air missile with an active radar seeker that is carried internally by stealthy fighters; and other advanced weapons that are designed to intercept U.S. surveillance aircraft and air refueling tankers, like the 400 kilometer-class PL-XX. The Royal United Services Institute (RUSI) has suggested PL-15s can outrange U.S. AIM-120C/D air-to-air missiles, which are a standard munition across the services for air superiority missions.⁷ China also has substantial inventories of other long-range weapons, like the DF-21D anti-ship ballistic missile (ASBM), anti-ship and land-attack cruise missiles, and hypersonic weapons that can strike U.S. bases and forces well beyond the first island chain in the Pacific. China continues to modernize its nuclear forces and now has an operational triad of nuclear-capable intercontinental ballistic missiles (ICBM), bombers, and submarine-launched ballistic missiles (SLBM). China's growing nuclear warhead inventory suggests the Asian superpower is shifting from maintaining a minimum force designed to retaliate in the event of a nuclear attack on China to a force that could "outpace the U.S. in the early 2030s."⁸ Overall, China's military modernization is on pace to prepare the PLA for a potential campaign to seize Taiwan by 2027 and become a "world-class force" by 2049.⁹

Long-range penetrating strike is key to defeating a Chinese *fait accompli*. The Air Force's penetrating bombers exist to provide weapons and sensor density at range that enable theater commanders to achieve a wide spectrum of effects against the most difficult target sets. More Air Force long-range, penetrating strike capacity is now required to defeat Chinese aggression in the Indo-Pacific and meet other NDS force sizing requirements. To a significant extent, the need for more long-range penetrating strike capacity is driven by theater commander requirements to counter China's operational advantages in a conflict that occurs along its periphery.

Compared to the United States, the PLA would be the "home team" should it attack Taiwan or conduct a similar operation elsewhere in the Western Pacific. Proximity to these battlespaces means the PLA power-projection forces would have shorter ranges to the fight from their mainland bases, simpler resupply lines, and protective cover from the dense array of sensors and other A2/AD systems deployed along China's coastline. U.S. forces, in contrast, would face significant logistical and warfighting challenges associated with operating hundreds or thousands of miles from their main operating bases. The PLA also has a deep weapons magazine and multiple bases distributed throughout China's vast interior that are out of range of currently fielded U.S. and allied conventional stand-off weapons. These stand-off weapons are the only alternate long-range strike tool available to commanders if they lack enough penetrating bombers.

U.S. forces will need to quickly counter these advantages to deter, dissuade, and, if necessary, defeat a Chinese *fait accompli*. Priority targets would include forces essential to China's offensive operations, like PLA Navy amphibious assault ships and the surface action groups (SAGs) shielding them, long-range coastal air defenses, and airbases generating PLAAF bomber and fighter sorties. This could require the Air Force to have the capacity to strike 100,000 or more aimpoints over long ranges—a reasonable estimate, considering U.S. air forces attacked about 40,000 aimpoints during Operation Desert Storm. It will also require stealthy aircraft that can operate in areas along China's periphery and its interior that will remain

highly contested *throughout* the conflict. This is a major departure from regional conflicts since the Cold War, where U.S. forces quickly established air and sea dominance to open the way for non-stealthy forces to operate with low risk.

Furthermore, some targets critical to defeating a PLA offensive could be located deep in China's interior, such as mobile ballistic missile launchers and anti-satellite weapon sites. Only penetrating bombers will have the range, survivability, persistence, and payloads to strike a peer adversary's high-value capabilities across the deep battlespace. The need to execute attacks into China's interior during a conflict will be a policy decision—but failing to develop the capability and capacity to do so will eliminate this option *and* a key means to maintain an effective deterrent.

Long-range stand-off strikes cannot replace penetrating bombers. A right-sized inventory of Air Force penetrating bombers should have the capacity to conduct the preponderance of U.S. long-range strikes to deny a Chinese *fait accompli*. Many of the forces that China would use for its initial assault operations, like SAGs and surface-to-surface missile launchers, will be moving or can quickly relocate. A high degree of target mobility can significantly degrade the effectiveness of U.S. long-range stand-off strikes. The time needed for guided missiles to fly—even at hypersonic speeds—hundreds of miles after they are launched by stand-off aircraft, ground batteries, or ships creates opportunities for the PLA to relocate potential targets and take other countermeasures. To put it bluntly, U.S. forces will need a variety of options to conduct long-range strikes beyond stand-off attack capabilities, especially if an adversary can easily move targets a few hundred feet left or right from their original locations to cause inbound stand-off weapons to miss them.

A better alternative is to use stealthy bombers to attack this class of targets. Only penetrating bombers have the survivability and mission persistence to locate, track, and strike large numbers of mobile/relocatable targets per sortie. Compared to bombers, fighter aircraft carry fewer weapons and have a combat mission radius of 650-700 nm or less. This means that in best-case scenarios, fighters operating from first island chain bases can reach parts of China's coastline, but not much further. Other attack platforms, like the Navy's aircraft carriers, may have to stand off 1,000 to 1,500 nm from China's coastline to reduce the threat of anti-ship missile attacks. These distances significantly exceed the combat radius of their embarked fighters and would greatly reduce the potential for carriers to attack targets in the Taiwan Strait and along China's coastline. Moreover, many carrier fighters would be dedicated to the "outer air battle" to defend their carriers against PLAAF bombers carrying anti-ship cruise missiles.¹⁰

The Difference Between Penetrating and Stand-off Strikes

Long-range strikes can be accomplished by stealthy aircraft that can operate in contested areas to deliver their weapons (penetrating) and non-stealth platforms that launch weapons while remaining outside contested environments (stand-off). Stand-off strike platforms include ships, ground launchers, and non-stealthy aircraft that cannot operate in dense A2/AD environments with acceptable risk.

Navy ships and attack submarines also have limited weapons magazines that could be depleted within a few days of high-intensity conflict, and in the case of ships, a good part of their magazines consists of defensive weapons to counter air and missile attacks. Both must return to secure ports to replenish their magazines since they cannot do this at sea, and many ports in-theater will be threatened by Chinese air and missile attacks. This means ships and submarines will be out of the fight for weeks at a time, unlike bombers that can regenerate and fly their next sorties within hours of returning to their airbases.

The need has never been greater. The operational need for a robust U.S. bomber force that can deter in peacetime and win in war has never been greater, and building it depends on the success of the Air Force's B-21 program. The Raider, with its long range, large weapons payload, and ability to penetrate highly contested environments, will be America's China deterrence bomber and the first choice to blunt a Chinese *fait accompli* campaign should deterrence fail. Except for the small B-2 fleet, no other U.S. or allied weapon system will bring a similar mix of capabilities to the fight.

On top of these operational needs, DOD must plan for combat attrition as it sizes its future bomber inventory. Today, the Air Force *does not have a bomber or fighter attrition reserve* adequate for a peer conflict. And as the Ukraine/Russia war spotlights, U.S. industry does not have the capacity to quickly replace combat losses or replenish PGM stocks that are already too small for a peer conflict. These shortfalls could encourage China, Russia, or other rogue states to engage in the kinds of opportunistic aggression the NDS seeks to deter.

As in the past, the main challenge to modernizing America's military for peer conflicts will likely hinge on budget issues, not operational requirements. Given pressures on the defense budget, DOD must focus its future investments on fielding the most *cost-effective* capabilities that have the greatest potential to defeat a Chinese *fait accompli* invasion and deter aggression elsewhere. The B-21 should be the leading candidate for increased investment. No other U.S. or allied capability will provide the same options to conduct high-capacity long-range strikes and perform a wide variety of other critical missions in highly contested threat environments.

Inevitably, there will be a temptation to shave funding from the B-21 program as it ramps up production because, in the parlance of DOD's programmers, "that's where the money is." To put it bluntly, resource pressures on the B-21 program will be magnified by annual budgets that do not meet all of the Department of the Air Force's (DAF) modernization, force structure, and readiness requirements.¹¹ It is no secret that decades of deferred modernization and curtailed programs have created an Air Force acquisition bow wave as the service must now modernize its fighter force, training aircraft inventory, multiple helicopter forces, aerial refueling fleet, uninhabited aerial vehicle force, two legs of the U.S. nuclear triad, C2 infrastructure, and its rapidly aging airlift inventory. On top of these challenges, the DAF must meet new joint all-domain command and control (JADC2) requirements and the growing needs of the Space Force. This could slow B-21 deliveries and once again lead to a smaller force that widens the gap between the *National Defense Strategy's* requirements and the strike capacity available to meet them. The threat is too high to allow this to happen. This is not the 1990s. Failing to deter China for near-term budgetary reasons could lead to outcomes in a war that have existential impacts on the United States and its allies and partners. That is the outcome that is truly unaffordable.

Recommendations

Based on this assessment and a mature body of evidence from related studies, the Mitchell Institute offers the following recommendations:

- 1. DOD should increase the range and payload capacity of its strike forces for peer conflicts.** DOD's past decisions to retire two-thirds of its bomber force created a combat aircraft inventory that is now over-balanced toward shorter-range fighter/attack aircraft. While this force was adequate for past operations against lesser regional adversaries, DOD requires much greater capacity for long-range strikes to defeat peer aggression in the vast expanses of the Indo-Pacific and deter other threats.
- 2. A total force of more than 300 bombers including 225 stealthy aircraft is needed to provide the penetrating strike capacity needed to defeat peer aggression.** Overwhelming strikes to rapidly attrit warships, armored vehicles, missile transporter-erector-launchers (TELEs), and other PLA offensive weapons will be critical to defeating a Chinese invasion of Taiwan and aggression elsewhere around the world. Many targets in future conflicts will be highly mobile or relocatable, which degrades the effectiveness of long-range stand-off strikes. Long-range weapons also lack warheads large enough to defeat very hardened or deeply buried targets, many of which could be located deep in China's interior. These and other stand-off attack limitations are why DOD decided to acquire penetrating B-21s. Multiple analyses have concluded the Air Force should field a future total force of at least 300 bombers including at least 225 stealthy B-21s with the range, large payloads, and penetrating strike sortie capacity to support the *U.S. National Defense Strategy*.¹²
- 3. Developing a force capable of conducting long-range strikes at scale will require DOD to prioritize cost-effective capabilities.** Defeating a Chinese invasion may require U.S. forces to strike 100,000 or more aimpoints. This means DOD must consider the cost-effectiveness of its long-range strike forces. DOD analyses have repeatedly shown that penetrating bombers capable of organically finding, tracking, and attacking multiple aimpoints per sortie are the more cost-effective means of striking large target sets over long ranges in contested areas.
- 4. A larger bomber force would also be the most cost-effective means to deter two near-peer nuclear adversaries.** Russia continues to modernize its nuclear triad, and China is in a strategic breakout, meaning it is increasing the size and capabilities of its nuclear forces to reach parity with or exceed the U.S. triad. Only the expansion of the nuclear and conventional dual-capable B-21 force offers a "two-for-one" cost-benefit with the potential to offset the growing threat from two near-peer nuclear adversaries and hedge against uncertainty across the conflict spectrum.
- 5. A robust B-21 acquisition rate is critical to deterring Chinese aggression.** The PLA may be prepared to assault Taiwan in an attempt to reunify it with the Chinese mainland later this decade, a timeline that coincides with the Air Force reaching an all-time low in the size of its combat air forces. Throttling B-21 acquisition during this critical period will increase the risk of a conflict with an opportunistic China that would result in costs that exceed any temporary program savings. B-21 acquisition must be accompanied by the aggressive procurement of advanced munitions suitable for penetrating strike operations at scale in highly contested environments. These weapons should be complemented with cost-effective longer-range munitions for stand-off bomber strikes against high-priority PLA targets in highly contested and degraded operating environments.

Introduction: The Hollowing-Out of America’s Bomber Force

In 1989, the Air Force’s bomber force consisted of 411 B-52s, F-111s, and then-new B-1s. Sized to deter nuclear threats and fight conventional conflicts during the Cold War, this force was instrumental to the decisive response that defeated Iraqi forces occupying Kuwait in 1991. B-52s alone flew 1,741 combat sorties and dropped 27,000 tons of weapons on Iraqi targets, which was 30 percent of all weapons by tonnage delivered by American air forces during Operation Desert Storm. Seven of these sorties flew directly from Barksdale Air Force Base in Louisiana to strike Iraqi power and communications nodes on the first night of the air campaign.¹³ These sorties, called Operation Senior Surprise by the Air Force—or “operation secret squirrel” by the crews that flew them—unambiguously demonstrated the ability of long-range bombers to strike any target on the face of the Earth.

Despite their proven effectiveness, multiple force cuts since then have reduced America’s bomber inventory to a total of 141 aircraft, most of which are the *exact same airframes*—B-52Hs and B-1Bs—that were on the ramp in 1990. This diminished force is a hallmark of what occurred after the Cold War as multiple DOD strategic reviews sized the Air Force’s combat air inventories to defeat aggression by rogue states like Iran and North Korea (see Table 1).¹⁴ Although labeled “strategic” reviews, most of these assessments were budget drills, which means they were driven by DOD’s desire to reduce defense spending and realize a post-Cold War peace dividend by trading force capacity to sustain and upgrade remaining forces.

Ten years after the Cold War, the Air Force had already divested nearly 40 percent of its bombers and fighters. Additional force cuts and modernization program delays since then have created a combat aircraft inventory that is now the service’s smallest ever. The growing gap between combat capacity and requirements for long-range strike created by these retirements was made even worse when the Air Force opted to retire 33 B-1s—again for budgetary reasons—on the eve of combat operations in Afghanistan

DOD Strategic Review	Bomber Force Sizing Decisions
1993 Bottom-Up Review	• 184 total bombers (100 bombers needed for one major theater war)
1997 Quadrennial Defense Review	• 142 operational bombers
2001 Quadrennial Defense Review	• 112 combat-coded bombers
2006 Quadrennial Defense Review	• Cut the B-52 force to 56 total aircraft (intent was to use resulting savings to modernize remaining bombers) • Directed the Air Force to field a new stealthy bomber by 2018
2010 Quadrennial Defense Review	• 96 primary mission aircraft • New stealthy bomber canceled by the Secretary of Defense in 2009
2014 Quadrennial Defense Review	• 96 primary mission aircraft (44 B-52H, 36 B-1B, 16 B-2)

Table 1: DOD’s post-Cold War strategic reviews created a smaller and older bomber force. These decisions nearly ignored the rise of China, Russia’s nuclear weapon modernization programs, and the global proliferation of advanced air defense systems.

Source: Mitchell Institute

in the early 2000s. This meant an even smaller B-1 force had to shoulder surging operational demands. In 2021, the Air Force retired another 17 of its swing-wing B-1Bs, reducing its B-1B inventory to less than half its original size. The Air Force justified this by citing the expense of depot-level repairs required to resolve structural issues created by flying B-1Bs on back-to-back deployments for years in support of counterterrorism operations. These cuts highlight the *real* reason for the service's bomber divestitures over the last 30 years: inadequate budgets that forced the Air Force to reduce its warfighting capacity and then use resulting savings to partially sustain its remaining forces. These divestitures were not accompanied by reduced operational demand for multi-mission bombers with global ranges and large payload capacities, a fact that created an even higher tempo for a smaller force that further accelerated its aging.

Today's bomber force is also the Air Force's oldest ever. The service accepted delivery of its newest B-52 when President Kennedy was in office, and delivery of its B-1Bs predated the invention of the World Wide Web in 1989. The Air Force intends to operate its B-52s until 2050, by which time they will have reached an unprecedented average age of 82 years. Currently, 20 stealthy B-2s are DOD's *only* long-range strike aircraft that can penetrate contested areas covered by advanced integrated air defense systems (IADS). Because of their large radar and infrared signatures, B-52Hs and B-1Bs are limited to using long-range missiles to launch stand-off strikes into contested areas while remaining outside an enemy's IADS coverage.

The 1992 decision by President George H.W. Bush to cap B-2 production at 21 aircraft effectively ended DOD's Cold War practice of periodically replacing the Air Force's older bombers with more advanced aircraft designed to evade the next generation of air defenses.¹⁵ Secretary of Defense William S. Cohen reaffirmed this decision in 1997, claiming more B-2s were not needed for conflicts with lesser rogue states. This was despite the 1997 QDR's finding that "additional B-2s deployed quickly to a conflict could improve our ability to halt an adversary's advance during the opening days of a major theater war" and "the B-2 could use less expensive munitions in more missions than existing aircraft."¹⁶ Instead, Cohen asserted that additional B-2s would "not provide the same weapons delivery capacity per day as the forces that would have to be retired to pay for B-2s."¹⁷ In other words, DOD cited a number of assumptions regarding potential conflicts with third-class regional militaries to rationalize its budget-driven B-2 decision:

- DOD could reduce the size of its bomber force because fighter aircraft operated by the Air Force, Navy, and Marine Corps could quickly deploy to a theater and provide the strike capacity needed to defeat regional aggression by Iran, North Korea, or other rogue states.
- These fighter forces could generate combat sorties in theater with few constraints because adversaries lacked the ability to launch high-intensity air and missile strikes against U.S. airbases and aircraft carriers.
- Joint force operations to defeat regional aggression did not require more than a small, "silver bullet" force of stealthy B-2s because of the lack of a serious threat to U.S. air supremacy. This was also part of DOD's 2009 rationale to curtail F-22 acquisition at 187 aircraft, far short of the Air Force's requirement for 381 F-22s.
- DOD could continue to upgrade its aging B-52s and B-1s to sustain their operational viability instead of replacing them with next-generation aircraft.

These assumptions have since proven incredibly short-sighted considering the rise of China’s military—which was already underway by the late 1990s—and Russia’s demonstrated willingness to use force to achieve its ambitions in Europe. Senior Air Force leaders understood this and sought to prepare for future high-end conflicts by beginning the process of developing a new penetrating bomber in the 2000s. The 2006 Quadrennial Defense Review (QDR) accelerated this effort by directing the Air Force to “develop a new land-based, penetrating long-range strike capability to be fielded by 2018 while modernizing the current bomber force.”¹⁸ A short three years later, Secretary Gates terminated the Next Generation Bomber program, citing the need to better understand requirements and technologies to develop a new bomber.¹⁹ The Office of Management and Budget responded to this decision by repeating the shopworn argument used to justify other modernization program cuts: “As a result of ongoing efforts to upgrade the existing bomber fleet with new electronic and weapons systems, *current aircraft will be able to meet the threats expected in the foreseeable future.*”²⁰ This and other assertions help explain why the Air Force’s bomber inventory and other combat air forces are now too small, too old, and lack enough lethality and survivability for a peer conflict.

In This Study

The remainder of this report is broken into three main sections. The first section explains the operational rationale behind the requirements for rebalancing DOD’s long-range strike forces toward penetrating bombers. The second section addresses the size of the future bomber force and why it must have sufficient capacity for a major conflict with China, a campaign to deter or defeat an opportunistic aggressor in another theater, and maintaining a force posture to deter nuclear attacks simultaneously. The final section makes the case for why DOD should maximize the B-21’s acquisition rate as soon as possible to deter peer aggression—including a potential Chinese assault on Taiwan that could occur later this decade. It also addresses initiatives to control the B-21’s unit cost that will help the Air Force to rapidly acquire a larger operational force of next-generation penetrating long-range strike aircraft.

Understanding Small Inventories: Why 20 is not 20...

The Air Force now has 20 B-2s in its inventory. This does not mean this force can generate 20 sorties every day during a conflict. First, only 16 of the service’s 20 B-2s are assigned to combat squadrons after subtracting the aircraft that are unavailable due to maintenance or testing requirements. Second, it is likely that some dual-capable B-2s would be withheld from deployment to deter nuclear attacks on the U.S. homeland, especially during conflicts with a near-peer nuclear power. And finally, flying long-duration missions across the vast expanses of the Indo-Pacific takes time, and means a B-2 may only be capable of generating 0.8 sorties per day or less on average. In other words, DOD’s long-range, penetrating strike capacity in a conflict with China could consist of only six to eight B-2 sorties per day depending on B-2 basing, sortie durations, and the time needed to turn aircraft between sorties. The loss of a single B-2 in combat or due to a peacetime accident would equal the loss of at least 10 percent of this sortie potential. This is the definition of a fragile force.

The Case for Penetrating Bombers

DOD, FFRDCs, and independent think tanks have completed multiple assessments over the last 30 years on the need for long-range penetrating bombers. With few exceptions, these analyses concluded that the attributes of penetrating bombers in high-end conflicts outweighed the advantages of long-range stand-off strikes.²¹ They are also more *cost-effective* than stand-off strikes, including strikes generated by aircraft carriers. Platforms like aircraft carriers have huge logistical requirements that are often hidden during analyses by assumptions that carriers can act without ties to land bases. While an aircraft carrier may have a nuclear powerplant that does not require refueling, the air wings they carry, the munitions they expend, and the personnel required to operate them require frequent resupply and replenishment.

These facts were not reflected in DOD decisions over the last 30 years that hollowed out its bomber force. Bomber inventory cuts and early termination of B-2 production following the end of the Cold War were driven more by a desire to reduce defense spending than operations and analyses that demonstrated no other force could match the ability of bombers to project lethal mass with precision at range. Results from DOD's 2009–2010 comprehensive bomber study finally helped break this pattern. The ability of penetrating bombers to create persistent and decisive effects in all threat environments is exactly why Air Force, DOD, and Congressional leaders concluded the nation must invest in the Long-Range Strike Bomber (LRS-B), now known as the B-21 Raider.

Penetrating Bombers Provide Options that are Unmatched by Other Strike Systems

The unique attributes of penetrating bombers enable them to perform multiple missions. The combination of long ranges, large payloads, onboard sensors, and other capabilities make penetrating bombers ideal platforms for conventional strikes, suppression of enemy air defenses (SEAD), close air support (CAS), and other missions in all threat environments. Using appropriate munitions, penetrating bombers can conduct maritime attacks and air-deliver sea mines deep in contested areas where it would be too risky for the Navy's surface ships to operate. Maritime strike is already a key mission for the B-1 bomber, which can carry up to 24 Long-Range Anti-Ship Missiles (LRASM) per sortie.²² And like other Air Force bombers, B-21s will be able to operate directly from the United States and overseas bases with less need for replenishment and aerial refueling compared to shorter-range aircraft and carrier air wings. This is a major advantage at the start of a conflict when Air Force tankers will be in extremely high demand to support deploying forces. The B-21's large weapons bays will also allow them to strike more targets per sortie compared to fighters, a critical factor during operations to blunt a PLA offensive. Plus, their ability to penetrate highly contested areas will allow B-21s to use smaller, shorter-range weapons that are more effective against a range of targets. This will increase the number and type of aimpoints that B-21s can strike per sortie compared to non-stealthy aircraft that must employ much larger stand-off weapons against the same targets.

Like B-52s and B-2s, the B-21 is designed to deliver nuclear as well as conventional weapons—known as “dual capability.” Bombers are the only leg of the U.S. nuclear triad that has the flexibility to be used for conventional, non-nuclear attacks. In a crisis, bombers can be postured to reduce their response times and dispersed to multiple bases to reduce their vulnerability to attacks. They are also the most visible leg of the U.S. nuclear triad. The ability of bombers to launch, remain on airborne alert, and then recover or proceed on their nuclear strike missions provides options to signal national resolve in a crisis that cannot be matched by nuclear-capable ICBMs or SLBMs.

It is important to understand that B-21s have attributes that are *not* shared by any other bomber to date. Unlike its predecessors, the B-21 was designed from the outset with an open mission architecture and the ability to accept future upgrades. This will allow the Air Force to rapidly integrate new mission systems and munitions into B-21s to adjust to evolving threats and take advantage of new technologies for decades to come. In other words, it may be possible to modify B-21s to meet a combatant commander’s urgent operational requirements during a crisis. According to General Timothy Ray, then-Commander of Air Force Global Strike Command, “It would take me years to integrate a new stand-off missile into the B-2, but with the B-21, given its open mission systems, it will take me months, not years.”²³ Future upgrades could even give B-21s the ability to operate as part of a *counterair* family of systems designed to defeat enemy air forces in contested areas. For instance, B-21s may be able to carry long-range air-to-air missiles and receive cues from the Next Generation Air Dominance (NGAD) aircraft or other sensor platforms to launch “see first—shoot first” intercepts of enemy fighters.

Penetrating bombers are the most effective means to strike mobile/relocatable targets. DOD has had a persistent shortfall in its capacity to strike large numbers of missile transporter erector launchers (TEL), surface-to-air missile (SAM) launchers, vehicle-based command and control centers, and other mobile and relocatable targets in contested areas. Mobilizing high-value targets has been widely embraced by



Figure 2: Characterizing trends in potential targets sets based on campaign objectives. During the deny and blunt phase of operations to defeat a Chinese or Russian *fait accompli* invasion, 90 percent of targets for airstrikes could consist of mobile targets.

Source: Col Chris Buckley, USAF, Chief of Weapons Development & Requirements, “[The End of the Kill Chain: The Weapons We Need to Arm the Air Force the Nation Needs.](#)” briefing to Weapons Pitch Day Conference on July 20–21, 2022, slide 4.

the world's militaries as a tactic to counter precision strikes. Today, many modern missile launchers and other mobile systems can fire their weapons, stow their sensors and other equipment, and then change their locations within minutes. This degree of mobility increases the need for an attacker to constantly monitor target areas and provide precise target location updates to remote strike systems. This is not a trivial challenge since the preponderance of a U.S. commander's priority targets could be highly mobile/relocatable depending on campaign objectives. For instance, if a commander's intent is to blunt and then prevent an adversary from completing a *fait accompli* invasion of a U.S. ally or partner state, then the preponderance of priority targets—like surface action groups, amphibious assault ships, and missile launchers—may be highly mobile.

A high degree of target mobility creates a major challenge for non-stealthy strike aircraft, ships, submarines, and ground launchers that must stand off hundreds of miles from a peer adversary's defenses to remain survivable. The simple reason for this is the flight time of a weapon after it is launched: the flight time of a cruise missile flying 400 nm to its target at high subsonic speeds could exceed 40 minutes. Weapon flight times could be even greater for surface-to-surface missiles that are launched from locations along the Pacific's first island chain and Navy ships that must stand off 1,000 nm or more from China's coastline defenses. These times would be well past the single-digit minutes needed for modern SAM systems and other mobile missile launchers to "shoot and scoot." Even if a stand-off weapon strikes its designated aimpoint with an incredible degree of precision, it's a wasted round if its target is no longer there. This is a win for the adversary's defense, which is exactly why China, Russia, and others are mobilizing their high-value weapon systems. Sustainable power projection at scale remains a challenge for U.S. and allied forces as long as these threats remain active.

It is possible to compensate for a target's movement, but this can significantly increase the cost and complexity of a weapon's "find, track, target, and attack" kill chain. The Air Force could use space-based and airborne sensors to track mobile/relocatable targets and then provide inflight updates to stand-off weapons that have datalinks. However, updating weapons at the scale required to defeat peer aggression—possibly hundreds of weapons at a time—would further tax the Air Force's already strained ISR forces. Plus, these sensors and datalinks may be susceptible to enemy jamming and other countermeasures. It is unrealistic to assume that U.S. forces operating in highly contested areas in future conflicts will have unimpeded connectivity. China has developed kinetic and non-kinetic capabilities to conduct counterspace operations "as a means to deter and counter a U.S. intervention during a regional military conflict."²⁴ Chinese sources also claim that suppressing U.S. overhead sensors and other ISR systems "would make it difficult for the U.S. and allied militaries to use precision-guided weapons."²⁵ Russia has developed similar measures for the same purpose. The more complex kill chains stand-off launchers rely upon can also increase the time needed to complete strikes over long ranges, which could also increase the need to provide weapons with updated aimpoint location information for mobile/relocatable targets.

Another approach is to design individual weapons with sophisticated sensors and the ability to loiter in target areas to find, identify, and then attack mobile targets. These features, combined with datalinks and other requirements, can increase weapon costs to the point where DOD may not be able to afford to buy them at the scale needed for peer conflict. Weapons with a powerplant, the capacity to carry enough fuel to fly long

distances and then loiter, control surfaces to maneuver, guidance systems, and target seekers can cost millions of dollars each. These weapons are like small, unmanned aircraft, but only in a sense. Unlike aircraft, a long-range stand-off weapon and all its expensive components are expended to strike a single target.

By contrast, penetrating bombers are sensor-shooter nodes that can organically close kill chains against mobile/relocatable targets in contested environments. This gives them an advantage over stand-off strike systems that depend on off-board sensors for target cues, especially in contested areas where space-based sensors and long-range datalinks may be degraded. A smart munition is no longer smart absent the necessary data inputs to achieve desired mission effects. The compressed kill chains of penetrating strike aircraft also reduce the time available to an adversary to counterattacks. It is one thing to be afforded an hour to move an asset, but quite another to detect incoming weapons, determine how to counter them, and then launch intercepts—all within a few minutes. Compressed kill chains that improve the probability that PGMs will reach their designated aimpoints could also reduce the total number of weapons and sorties needed to strike large target sets. This is critical at the onset of a campaign when time and resources can make the difference between success and failure.

Penetrating bombers are the best means to strike very hard/deeply buried targets over long ranges.

Hardening/deeply burying high-value military assets and installations that cannot easily relocate is another countermeasure against precision strikes that is widely practiced by China, Russia, North Korea, Iran, and other adversaries. Killing hardened targets like aircraft shelters, C2 centers, and weapons storage facilities typically requires large, hardened warheads that are specially designed to penetrate layers of concrete and other protective materials. Destroying some very hard/deeply buried targets may require extremely large penetrating weapons like 5,000-pound “bunker buster” bombs or 30,000-pound GBU-57A/B Massive Ordnance Penetrators (MOP) that can be delivered by B-2s. To put it simply, that is the size of a sport utility vehicle. As a rule of thumb, long-range missiles simply cannot carry warheads large enough for many hardened/deeply buried targets, which is why it is a widespread countermeasure against precision strikes. Just look at the size of the boosters required to launch large satellites into space. Large missile payloads radically increase the cost and complexity of delivering them over long ranges, whether the terminal destination is an orbit or a surface target aimpoint. Given this reality, it is little mystery why theater commanders require stealthy bombers that have the capacity to deliver munitions with larger penetrating warheads.

Penetrating bombers are more cost-effective than stand-off strikes.

Compared to stand-off weapon launchers, penetrating bombers are the most cost-effective means to deliver large payloads of weapons into contested areas during a peer conflict. Figure 3, also adapted from an Air Force briefing, helps illustrate the relationships between different classes of targets, the weapons used to attack them, and the aircraft that can deliver the weapons. The figure’s horizontal axis represents the scale of a potential target set that includes fixed, mobile, hardened/deeply buried targets, and the vertical axis represents weapon and aircraft costs. “Exquisite strike” weapons at the apex of the target triangle that “make their own access” could include stand-off hypersonic boost-glide weapons capable of penetrating enemy defenses, but these cost over ten million dollars each—which means ten million dollars or more per target. Because of their high costs, these weapons should only be used against an extremely limited number of very high-value targets.



Figure 3: Target "pyramid" comparing the costs and capacity requirements for stand-off weapons and short-range weapons that can be delivered by penetrating aircraft. The horizontal axis of the figure represents the size of a potential target set that includes fixed, mobile, and hardened/deeply buried targets, and the vertical axis represents the relationship between weapon costs and the aircraft that deliver them. Source: "The End of the Kill Chain: The Weapons We Need to Arm the Air Force the Nation Needs."

The triangle's base represents the much larger number of weapons that can be delivered by penetrating aircraft since these weapons are typically much smaller (and less expensive) than long-range stand-off missiles. Smaller weapon sizes are important since they can increase the number of targets that stealth aircraft can strike per sortie. For instance, a B-2 bomber can carry up to 80 weapons the size of a 500-lb class short-range Joint Direct Attack Munition (JDAM) or up to 16 larger Joint Air-to-Surface Standoff Missiles (JASSM) per sortie. In an operational context, maximizing weapons—target kills—per sortie can have a decisive impact during a campaign to rapidly blunt and then halt a Chinese offensive.

The cost-effectiveness of penetrating bombers is even more apparent when compared to long-range surface-to-surface launchers. As a rule of thumb, a PGM's cost correlates with its range, technical sophistication, and its launch mode. A short-range air-delivered JDAM with a simple GPS guidance unit costs tens of thousands of dollars; a more sophisticated mid-range Small Diameter Bomb II glide weapon costs about \$200,000; and a powered JASSM-ER that has a range exceeding 500 nm costs about \$1.2 million each. By comparison, surface-to-surface weapons require much larger rocket boosters to accelerate them from zero altitude and speed into trajectories that allow them to reach their targets over long ranges. This increases the size and cost of surface-launched weapons—in some cases, to the point where it is impractical to buy them at the scale needed for peer conflict. The Army's much-vaunted surface-to-surface Long-Range Hypersonic Weapon (LRHW) may have sufficient range to launch from Guam and reach targets along China's coastline, but they could also cost over \$50 million or more each, and that's to destroy a single target.²⁶ Just about \$20 million more would acquire an F-35A which could fly thousands of sorties over

its decades-long lifespan. Spending \$50 million for a weapon to destroy a single target is exactly the kind of investment that places the United States on the wrong side of the cost imposition curve against China.

This example highlights the measure that is most important is the *cost-effectiveness* of long-range precision strikes, not just weapon unit costs. Figure 4 illustrates how a penetrating bomber can be far more cost-effective than stand-off launchers, even when factoring in the cost to acquire, operate, and sustain a new penetrating bomber for 30 years.

As the figure shows, the cost of LRHWs and their launcher could quickly exceed the cost of buying a new stealth bomber, operating and supporting it for a 30-year period, and procuring its payloads of mid-range Stand-in Attack Weapons (SIAW), which cost about \$1.3 million per weapon.²⁷ Bombers are also reusable assets that can fly multiple missions, while an LHRW is expended on a single target. The same is true for the second example in Figure 4, which compares LRHWs against a non-stealthy B-52 that delivers airbreathing (scramjet) hypersonic cruise missiles that cost \$4–5 million each. In this case, even the cost of these cruise missiles combined with the cost to operate and support the B-52 over 30 years is quickly exceeded by the LRHW alternative.

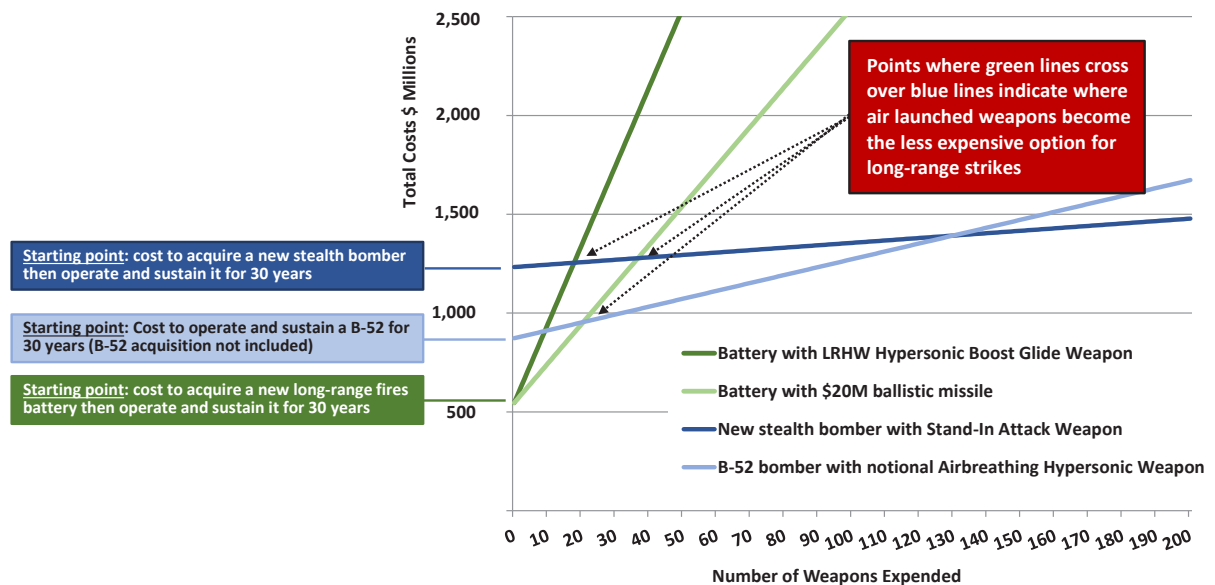


Figure 4: Comparing the cost of long-range strike alternatives. The dark blue line includes the cost to acquire a new stealth bomber, operate and support (O&S) it for 30 years, and the weapons it expends. The dark green line includes the cost to acquire a LRHW missile battery, its 30-year O&S costs, plus the weapons it launches. The B-52 example includes O&S costs and the cost of notional airbreathing hypersonic weapons it launches, not its acquisition cost since B-52s are an existing capability. All U.S. strike systems that operate inside Chinese A2/AD threat envelopes will need to be supported by defensive systems. The cost of these defenses is assumed to be roughly comparable for the different alternatives and are not included in the comparison. Ground-based missile batteries will also need significant logistics support to sustain their operations. Depending on the threat, bombers may need support from other aircraft to counter enemy air patrols and potentially attack enemy air defenses. They will also require aerial refueling for very long-range operations. These costs are assumed to be roughly equivalent for the purposes of this comparison.

Source: Mitchell Institute; see also Kelley M. Saylor, *Hypersonic Weapons: Background and Issues for Congress* (Washington, DC: Congressional Research Service, October 27, 2022), pp. 6–7; Department of Defense, *Fiscal Year 2023 Budget Estimates, Air Force Justification Book Volume 1 of 1, Missile Procurement, Air Force* (Washington, DC: DOD, April 2022), p. 105.

This comparison does not include some indirect costs of these alternatives, such as the cost of logistics to deploy and sustain ground launchers. Army long-range strike systems are large and heavy and rely on Air Force airlift to deploy into a theater and provide them with missile reloads. Airlift demands will already be stretched far too thin over a limited force of C-17s and C-5s during a peer conflict; adding more requirements to the mix may prove unsupportable given other competing COCOM demands, especially demands for rapid missile resupply. Like other stand-off strike systems, ground-based missile batteries will also require target information provided by space-based and airborne sensors, fire control centers, and other capabilities to complete their find, fix or track, and target kill chains. These supporting assets increase the complexity—and cost—of stand-off launchers compared to penetrating bombers that are sensor-shooter nodes. It is also important to consider the cost of defending these missile batteries from adversary counter fires. These defenses do not yet exist in volume or at a cost deemed viable for mass use. This challenge impacts *all* forward-deployed joint force entities.

Advantages of the B-21 as Lead Component of a Long-Range Strike Family of Systems

On December 2, 2022, the Air Force revealed the first production representative next-generation B-21 stealth bomber in Palmdale, California. The service also announced its future B-21 force will be the foundation “of a larger family of systems that will deliver intelligence, surveillance and reconnaissance, electronic attack and multi-domain networking capabilities” for penetrating strikes.²⁸ Unlike earlier bombers, the B-21 was conceived from the outset as the lead component of a long-range strike family of systems that could include other manned and uninhabited aircraft that act as extended-range sensors and perform other tasks. This family will also include new munitions that have low-observable characteristics and other capabilities that increase their survivability and lethality in contested environments.

There are capability and cost benefits to designing the B-21 as part of a family of systems. First, adopting a systems-of-systems design approach creates opportunities to offload some capabilities from a new bomber design to other systems in the family. This could include some sensors and other emitters that would be more suitable for uninhabited aircraft to employ in contested environments since these emissions could be detected by enemy defenses. Offloading some mission systems could also reduce the B-21’s overall cost and free capacity for it to carry additional munitions and other lethal capabilities.

Adopting a family-of-systems force design could likewise increase the *survivability* of penetrating force packages. There are obvious advantages to a B-21’s next-generation stealth, which is a product of its advanced low-observable shape, exterior coatings that absorb radar energy, sensors, in-cockpit information fusion, and smart mission planning tools to direct the aircraft around high-risk threats. B-21 survivability can be further enhanced by operating them in collaboration with other systems in ways that present adversaries with a more difficult defensive challenge. Instead of concentrating its efforts on finding and tracking lone penetrating B-21s, an adversary will need to characterize an attacking force that could include multiple manned and uninhabited aircraft, jammers, and other airborne systems that are part of long-range strike packages. This can complicate an adversary’s ability to prioritize threats and force it to expend its best defenses against false targets, decoys, and other lower-value systems instead of B-21s.

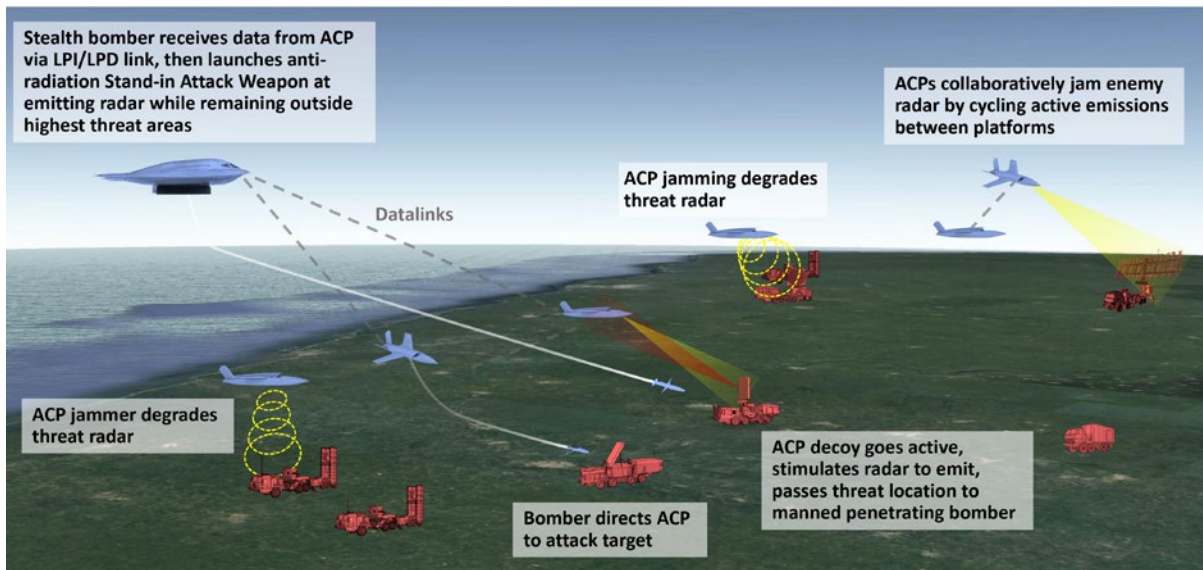


Figure 5: Operations of a family of systems could increase the survivability and lethality of Air Force long-range penetrating strikes.

Source: Mitchell Institute

B-21s will help enable manned-unmanned collaborative operations at scale. A family-of-systems force design also creates opportunities for the Air Force to use next-generation UAVs in ways that will further increase the B-21's survivability and lethality. Penetrating bombers could be accompanied by or even carry AI-enhanced autonomous collaborative platforms (ACP) that the Air Force is developing for multiple missions in contested airspace.²⁹ ACPs with active or passive sensors could locate targets—including moving targets—and pass cues to B-21s without the need for the bombers to use their radars or emit other detectable energy. Other ACPs could act as jammers or otherwise emit to stimulate enemy defenses to react in ways that can be detected (see Figure 5). A bomber crew could then suppress or maneuver to avoid these threats.

B-21s could also help the Air Force to operate ACPs at the scale it envisions for peer conflicts by acting as long-endurance information gateways, ISR nodes, and even “quarterbacks” for ACPs that are distributed across large areas. And unlike single-seat fighters, multi-crew bombers would have greater human cognitive capacity to perform as airborne ACP battle managers in combat environments. In combination, these attributes will make manned bombers—not just ACPs—force multipliers in future systems-of-systems operations.

This highlights a key point concerning ACP teaming operations. There is debate over the potential for ACPs to replace some number of next-generation fighters, bombers, and other manned aircraft. However, their real value will be realized by developing operating concepts that *most effectively combine* the different attributes of manned aircraft and ACPs. Both have strengths and weaknesses, and smart integration will ensure the sum of the two will yield a whole that is greater than individual aircraft alone. In other words, ACPs will be complimentary and additive to penetrating bombers, not their substitutes. Treating them as such will help the Air Force increase the capacity, survivability, and lethality of its long-range strike forces.

A more balanced PGM mix is also needed. DOD must also develop a new family of PGMs to take full advantage of its future fleet of penetrating bombers and fighters. These PGMs should be designed to survive and reach their targets in highly contested threat environments since advanced IADS are increasingly capable against individual munitions like non-stealthy cruise missiles as well as 4th generation aircraft. Using less survivable weapons reduces strike effectiveness, which can increase the total number of PGMs—and aircraft sorties—required to attack target sets. These additional assets may not be available early in a conflict with China.

New munitions suitable for 5th generation combat aircraft and beyond should also have just enough range to increase options for aircrews to maneuver to avoid threats and strike targets in contested environments. Very short-range, direct attack munitions like JDAMs that constitute a large part of the Air Force's PGM inventory would require bombers to nearly overfly their designated aimpoints. This proximity would increase the potential that enemy defenses surrounding high-value targets could gain enough information to track and attack the bombers. On the other hand, weapons that have excessive stand-off ranges are typically larger than direct attack munitions, which can reduce the number that stealthy aircraft can carry internally. A better alternative is to field a new family of PGMs with ranges of 50 nm to 150 nm that are sized to take maximum advantage of the internal capacity of stealthy bomber weapon bays.³⁰

The Air Force's future long-range strike family of systems is a major step toward fielding a force design that will have the right mix of modernized capabilities needed in an era of renewed great power competition and conflict. It is also the only force in the U.S. military that can conduct conventional and nuclear strike missions—a two-for-one bargain—and expand options for theater commanders to strike the most challenging targets globally. The next-generation B-21 will soon be the new foundation for this family of systems. Secretary of Defense Lloyd J. Austin III has cited the B-21 as the first tangible proof “of the department's long-term commitment to building advanced capabilities that will fortify America's ability to deter aggression, today and into the future.”³¹ This is exactly right, and the B-21's ability to deter threats, assure America's allies and partners, and conduct decisive combat operations will be the real measure of its success.

America's Deterrence Bomber

“We at [the] Department of Defense need to have the capabilities and the concepts to deny the type of rapid *fait accompli* scenarios that we know potential adversaries are contemplating, so they can't make a rapid lunge at our partners and allies before they believe the United States can show up.”

*-DOD Undersecretary of Defense for Policy*³²

A U.S. military that can deter great power aggression must have credible capabilities and the force capacity to convince adversaries that their own warfighting strategies will fail. Capacity at the necessary scale would enable U.S. forces to strike thousands of targets associated with a peer adversary's power-projection forces and centers of gravity in, literally, hundreds of hours in contested environments. The same holds true for a conflict with North Korea or Iran. This core *National Defense Strategy* requirement cannot be realized without the range, survivability, and weapon loads of a long-range family of systems that is centered on the B-21. The Raider was designed from the core with the capabilities needed to deny a Chinese *fait accompli*—it is America's deterrence bomber. No other U.S. military capability has the potential to equal the B-21's contributions on night one of a campaign to halt a PLA invasion and create other conditions required for victory.

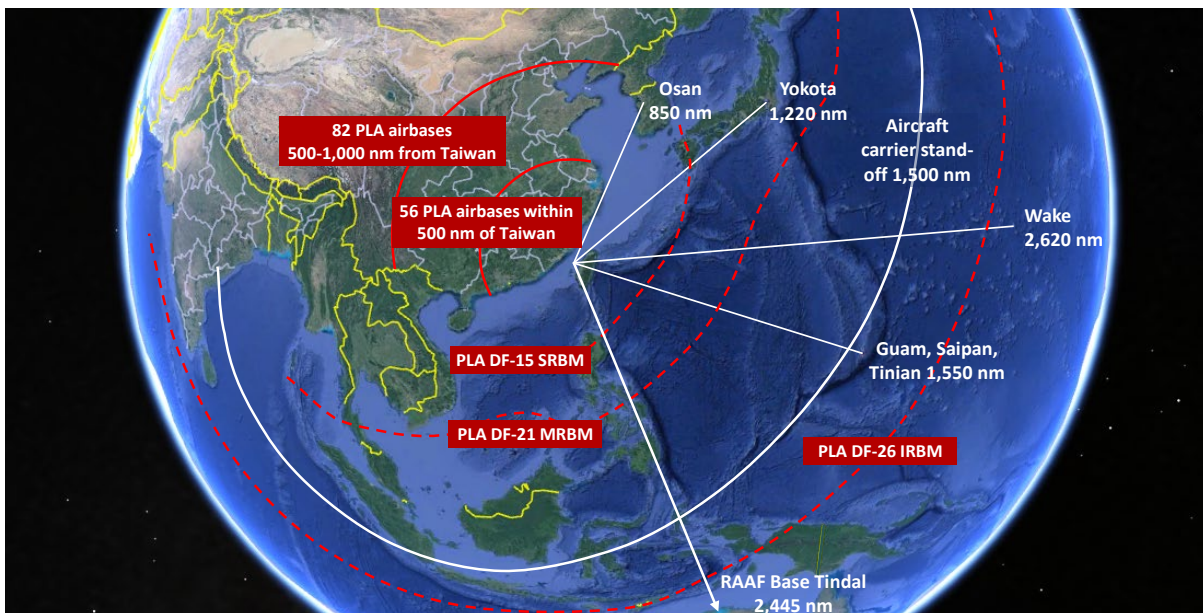


Figure 6: PLA fighters based on the mainland would have reduced transit times and longer dwell times in engagement areas compared to U.S. fighters operating from the first and second island chains. The same is true for U.S. Navy fighters operating from carriers that must stand off 1,000 nm or more from China's coastline to reduce the threat of PLA missile attacks.

Source: Mitchell Institute



Figure 7: Notional PLA assault on Taiwan. Proximity to the operational area would enable PLA land-based ballistic missiles, armed drones, and fighters to strike targets and create other effects across Taiwan. Source: Mitchell Institute, derived from multiple unclassified sources. For a description of a notional PLA invasion of Taiwan, see Samson Ellis, “[Here’s What Could Happen If China Invaded Taiwan](#),” *Bloomberg*, October 8, 2020; and Ian Easton, *The Chinese Invasion Threat: Taiwan’s Defense and American Strategy in Asia* (Manchester, UK: Eastbridge Books, 2017).

Defeating a Chinese *Fait Accompli* Campaign

The 2018 *National Defense Strategy* successfully reoriented DOD’s planning and resource priorities toward great power competition and conflict instead of defeating lesser regional aggressors and conducting large-scale counterterrorism and counterinsurgency campaigns. Defeating Chinese aggression in the Indo-Pacific and deterring Russia and other threats are now DOD’s cornerstone force design requirements. Specifically, the services must organize, train, and equip their forces to blunt and then deny a peer adversary’s *fait accompli* campaign to seize an area it seeks to control by force of arms. In the case of China, this includes defeating a PLA offensive to occupy Taiwan or other areas in the South China Sea that China falsely claims as its sovereign territory. This is the new pacing challenge for sizing and shaping DOD’s forces.

The long ranges involved in projecting power against the PLA in the Indo-Pacific would stress the U.S. military’s current force design, which was optimized after the Cold War for lesser regional conflicts in far more confined and less contested battlespaces. U.S. forces have grown accustomed to freely accessing bases located close to an operating area, surrounding it with a variety of forces, and then executing sustained, short-range operations with manageable risk from enemy defenses. This paradigm generally holds true for regional conflicts extending back to the Korean War. It will not hold true in a fight with China.

For instance, U.S. aircraft operating from Guam, northern Australia, and Japan must fly hundreds of miles to reach the battlespace around the Taiwan Strait, which is adjacent to China's mainland. This would stress DOD's current fixed-wing combat aircraft fleets that overwhelmingly consist of fighters with a mission radius of 650–700 nm or less, depending on their payloads and mission profiles. To put this in context, 700 nm is like flying from Washington, DC, to Tampa and back, while ranges from Australia to the Taiwan Strait are more like flying from Washington, DC, to Juneau, Alaska, and back—all in a single mission. Fighters operating from bases along the first and second island chains in the Pacific or from distant aircraft carriers would require aerial refueling to reach targets in the Taiwan Strait and then return to their bases. And due to PRC missile threats inside this range, carriers would be of little use in attacking targets located in the Taiwan Strait in a defense of Taiwan scenario.

This range disparity would give the PLA several operational advantages. For instance, there are obvious logistical advantages when it comes to sustaining forces on home turf. The PLA could regenerate combat aircraft for follow-on sorties in shorter periods of time and use short-range land-based missiles to increase the intensity and mass of its strikes across the 100 nm wide Taiwan Strait (see Figure 7). The PLA's amphibious assault forces and other power-projection systems would operate under the umbrella of coastal and sea-based air and missile defenses that extend hundreds of miles from China's coastline. At the campaign level, multiple wargames indicate that China may be able to achieve a *fait accompli* invasion of Taiwan if allied forces do not respond decisively within days. According to the RAND Corporation, the “decisive phase of the war could conclude within a matter of 10 days or so.”³³ The same may be true for a future Russian invasion of the Baltic Sea region in which wargames have suggested Russian forces could seize the capital cities of Estonia and Latvia in less than three days—well before NATO ground reinforcements could reach the fight in large numbers.³⁴

A More Balanced Combat Air Force Mix is Needed

Overcoming the challenges associated with defeating a Chinese assault on Taiwan or other *fait accompli* campaign will require U.S. air forces with modern attributes, not the capabilities of 4th generation and earlier combat aircraft that were designed 40 to 50 years ago. These attributes must include increased range and mission persistence; the ability to strike moving/relocatable targets at scale; and all-aspect broadband stealth to operate in highly contested environments.

- **Increased range and mission persistence.** The preponderance—more than 92 percent—of the Air Force's combat air forces now consists of fighter/attack aircraft that have a mission radius of 650–700 nm or less without aerial refueling. These limited ranges are why the Air Force would have to posture its fighters along the Pacific's first island chain and other close-in operating locations that are at risk of high-density Chinese air and missile attacks. Shifting the service's force mix toward bombers with enough range to operate from areas that are located further from the Chinese mainland, such as Guam, northern Australia, Diego Garcia, and even Alaska, would reduce this risk. Furthermore, bombers have enough range and mission persistence after arriving at their distant target areas to find, track, target, and attack forces that are centers of gravity for a PLA offensive, including high-value targets located in China's interior.

- **Increased capacity to engage moving targets at scale.** The Air Force’s diminished combat aircraft inventory lacks sufficient capacity to kill large numbers of highly dynamic targets at range, which is why Secretary Kendall established “achieving moving target engagement at scale in a challenging operational environment” as one of the Department of the Air Force’s (DAF) top operational imperatives.³⁵ Rapidly concentrating offensive mass at range to strike these targets translates directly to the time needed to defeat a Chinese assault and achieve a theater commander’s other campaign objectives. This is why fielding penetrating B-21s that can independently search for, track, and then attack moving targets at scale in areas where long-range datalinks may be degraded or temporarily denied is the centerpiece of this operational imperative.
- **All-aspect, broadband stealth: a threshold requirement.** U.S. air forces must be capable of projecting decisive combat mass to defeat a Chinese *fait accompli* without first establishing domain dominance. This will require next-generation stealthy aircraft that are designed to survive in highly contested environments. The B-21 has the right attributes for these environments, including all-aspect, broadband signature control to reduce the probability they will be detected and tracked by advanced air defenses. The B-21 is generations ahead of the F-117, America’s first operational stealthy fighter, which primarily depended on its shape and radar-absorbing coatings for its low observability. F-117s were optimized to reduce their signature in their frontal aspect against radars that operated in a small part of the electromagnetic spectrum. The B-21’s flying wing shape is designed for 360-degree all-aspect low observability across a much broader part of the spectrum. The Raider also benefits from next-generation radar-absorbing materials, far more advanced computing power, the ability to fuse multiple sources of threat information, and software that optimizes its flight path to minimize its potential to be tracked. In the words of Secretary of Defense Austin, the combined effect of these next-generation capabilities means that “even the most sophisticated air-defense systems will struggle to detect a B-21 in the sky.”³⁶

In summary, the Air Force’s current combat inventory lacks enough aircraft with the range, payload capacity, and all-aspect, broadband stealth to conduct decisive operations at scale in highly contested environments. Only the Air Force’s B-2s can presently meet these requirements with an acceptable degree of risk, and the operational demand for these capabilities in a peer conflict will clearly exceed what can be delivered by the very small B-2 force. The solution to this shortfall is now available—a force of next-generation penetrating B-21 bombers sized to meet the requirements of America’s combatant commanders.

Sizing the Future Bomber Force

In 2018, the Air Force proposed increasing its forces from 312 to 386 operational squadrons by 2030 to meet the growing operational demand for airpower. This proposal included increasing the service's bomber force by 80 percent, from five to nine operational squadrons. It is clear that progress toward developing a larger Air Force is at a standstill. Force capacity shortfalls combined with the Air Force's slow pace of modernization and reduced readiness is why one highly respected think tank recently rated the service's ability to meet its wartime requirements as "very weak."³⁷ Multiple independent studies have also recommended increasing the Air Force's combat capacity even as it invests in next-generation capabilities for peer conflict. This larger force should include at least 225 penetrating B-21s and 76 modernized B-52s to provide the long-range strike capacity needed for three critical operational demands: defeating Chinese aggression in the Indo-Pacific, deterring aggression by a second opportunistic aggressor, and deterring nuclear attacks by Russia *and* China. Sizing the bomber force for these operational demands would shift the Air Force toward a force mix that is more lethal, resilient, and able to operate in highly contested environments—all requirements of the *U.S. National Defense Strategy*.

1. The Bomber Force Must Be Sized for a Major Conflict with China

A continuing capacity challenge: Today's bomber force is too small and may get smaller. Today's bomber inventory is still sized for lesser conflicts of the past, not sustained operations at the scale needed to defeat Chinese aggression. In fact, force cuts after the Cold War diminished the Air Force's bomber inventory to the point where it was severely strained to support counterterrorism and counterinsurgency operations in the 2000s and 2010s. The B-1B is the premier example of this. Some 65 to 70 percent of the

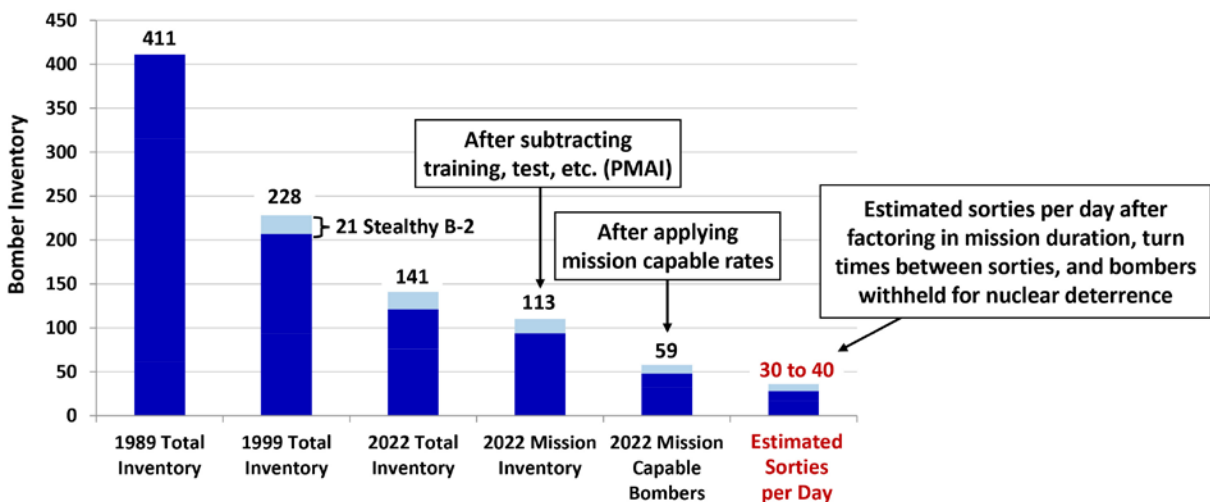


Figure 8: Today's bomber inventory is about a third the size of the 1989 force, and 113 of these aircraft are assigned to combat units. After applying mission-capable rates, an estimated 59 bombers may be available for day-to-day operations. After factoring in mission durations, turn times between sorties, and aircraft withheld for nuclear deterrence, this force may be capable of generating an estimated 30–40 sorties per day or less as a campaign progresses, and most of these sorties would be stand-off strikes.

Source: Mitchell Institute; inventory data provided by the Air Force and mission-capable rates are from a 2021 Air Force database.

Air Force's B-1Bs continuously flew missions in support of operations in the U.S. Central Command's area of responsibility for well over a decade, which led to aircraft structural issues that greatly degraded their readiness.³⁸

The Air Force's bomber force exists to provide weapons and sensor density at range that enable theater commanders to achieve a wide range of effects against the most difficult target sets. The bomber inventory has now reached an all-time low of 141 total aircraft (see Figure 8).³⁹ Theoretically, this force could generate up to 59 sorties per day at the start of a conflict after subtracting training, test, and backup inventory aircraft and applying mission-capable rates. The reality is available bomber sorties would be significantly fewer since it is likely that some nuclear-capable B-2s and B-52Hs would be withheld from deployments to deter nuclear attacks on the U.S. homeland, especially during a conflict with a near-peer nuclear adversary. Furthermore, a deployed bomber might only be able to generate an average of 0.7 to 0.8 sorties per day or less, depending on its airbase location, its mission duration, and the time needed to regenerate for its next sortie. This could drop the entire bomber force's sortie count to 30 to 40 per day. Finally, all sorties are not equal. At best, the entirety of the small B-2 force could generate about six to eight sorties per day. An eight-sortie-a-day fleet will not provide the penetrating strike capacity needed to rapidly blunt and then defeat a Chinese invasion of Taiwan, much less replace bombers lost in combat.

2. Size the Bomber Force to Credibly Deter a Second Aggressor

Sizing the Air Force's bomber inventory and other combat air forces for a single peer conflict will increase the risk that a second adversary could take advantage of the U.S. military's engagement in another theater. The Air Force must instead be sized to reduce this risk. A more credible deterrent should include a bomber force that has the capacity to fight in the Pacific and simultaneously respond to aggression in Europe or another theater. Anything less will further erode our military's combat effectiveness and ability to deter conflict in the first place.

DOD includes a force planning construct as part of its NDS that provides guidance on the type, number, and frequency of major conflict scenarios and other assumptions the services must use to size their forces. For nearly 30 years after the Cold War, the force capacity to fight two wars was considered critical to national defense. This changed when DOD adopted a new force planning construct in 2018 that required the services to size to fight a single war with China or Russia and deter—but not defeat—a second, lesser aggressor such as North Korea or Iran. According to the Congressionally appointed 2018 National Defense Strategy Commission, the shift toward a one-war U.S. military leaves the United States “at risk of being overwhelmed should its military be forced to fight on two or more fronts simultaneously.”⁴⁰

Although this change may be rooted in a presumption that a two-war force is no longer affordable, it increases the risk that a second adversary could launch an operation that would result in far more costly consequences. Just look at the bill the global community is footing given the war in Ukraine, not to mention the direct costs paid by Ukrainians—lives lost, homes destroyed, and families shattered.

This two-war risk should be a significant concern given China's willingness to use the PLA to achieve its hegemonic ambitions in the Indo-Pacific, Russia's initiation of the largest conflict in Europe since World War II, Iran's nuclear weapon ambitions, and North Korea's growing inventory of long-range missiles. Moreover, DOD cannot rely on the defense industry to rapidly rebuild its force capacity to hedge against a second conflict during a crisis. The U.S. industrial base was known as the "arsenal of democracy" during World War II, but even then, it required two full years (1942 and 1943) for its industrial capacity to surge to meet wartime demands. And today's weapons systems are far more complex, a challenge that is amplified by the fact that DOD "is increasingly reliant on a smaller number of contractors" for critical components such as microchips that are needed to surge defense production.⁴¹ It will take years of government and industry investment to increase defense production capacity rates from current levels that were optimized over the last 30 years to meet requirements for lesser regional conflicts and counterterrorism operations.

Part of the answer is that DOD, not every service independently, should selectively increase its force capacity to hedge against a second conflict. The Navy and Marine Corps should size and shape their forces primarily for an air, maritime, space, and cyberspace conflict with China in the Indo-Pacific. An operation in Europe to defeat Russian aggression would predominately occur on the ground, in the air, and in space and cyberspace, which is why it should be the Army's pacing threat for sizing its forces, not a Pacific conflict.

By contrast, the Air Force should size its forces—especially its bomber inventory—to defeat peer aggression in *both* theaters. The Air Force possesses unique capabilities that no other service can bring to the fight. These include a long-range strike family of systems with the capacity to strike thousands of targets in hundreds of hours, the largest aerial refueling force in the world, and 5th generation aircraft to operate in contested airspace. Air Force bombers can also strike enemy forces from bases located inside a theater of operations or from far more remote locations, including the U.S. homeland. The bomber force's ability to operate from range increases the Air Force's basing options and reduces an adversary's ability to concentrate its strikes on a small number of U.S. main operating bases located close to the adversary's borders. And unlike forces that are tied to maneuvering on the Earth's surface, bombers can rapidly swing from one theater to another to meet emerging operational demands. These and other attributes of long-range bombers are critical to preventing a second crisis from escalating to a conflict, and a second conflict from ending in a failure that would have devastating consequences for the United States and its allies.

3. Another Requirement: Sizing for Nuclear Deterrence

Given that both Russia *and* China now have operational nuclear triads, it is time to consider increasing the size of the U.S. triad to deter two near-peer nuclear adversaries. Dual-capable bombers are the most logical candidate to create this hedge.

The NDS requires the Air Force to size its bomber force to deter or respond to nuclear attacks. This is an additive sizing requirement, which means that some number of bombers may be withheld for nuclear deterrence and not deployed to theater conflicts or other taskings. In the past, the U.S. has sized its triad forces primarily to deter a single nuclear peer adversary—the Soviet Union and then the Russian Federation

after the Cold War. The New START Treaty, which entered into force in 2011, limits the U.S. and Russian Federation’s operationally deployed nuclear forces to a maximum of “1,550 nuclear warheads on deployed ICBMs, deployed SLBMs, and deployed heavy bombers equipped for nuclear armaments (each such heavy bomber is counted as one warhead toward this limit).”⁴²

The nuclear threats facing the United States now exceed the deterrence potential of a triad that is drastically downsized from its Cold War levels. Unlike the United States, Russia never stopped modernizing its nuclear forces after the Cold War, and it maintains an inventory of at least 2,000 shorter-range nuclear systems that do not fall under the New START Treaty’s limitations. These are the kind of weapons that Russia could use to threaten nuclear escalation during a conflict with NATO.⁴³ China also matured its nuclear forces over the past 20 years and is in the midst of a rapid nuclear build-up that could create a force of “at least 1,000 warheads by 2030, greatly exceeding previous DOD estimates.”⁴⁴ When asked if the United States should consider changing the size of its triad to meet this growing threat, ADM Charles Richard, then-Commander of the U.S. Strategic Command, said, “The answer is yes ... It is clear what we have today is the absolute minimum, and we are going to have to ask ourselves what additional capability, capacity, and posture do we need based on where the threat is going.”⁴⁵

Dual-capable B-21s would be the most cost-effective means of quickly increasing the size of the U.S. triad compared to expanding the Air Force’s ICBM fields or acquiring additional *Columbia*-class submarines, which may be built sometime in the 2040s. B-21s will soon be daily fliers that can be tasked to support other global operational requirements or placed on nuclear alert in the event of a crisis. Moreover, each nuclear-capable B-21 would count as a single warhead if New START warhead counting rules apply to future arms control agreements, a fact that would favor the United States. No other alternative offers this “two-for-one” advantage or has the same potential to hedge against the uncertainty that spans the spectrum of conflict.

Multiple Studies Have Recommended a Larger Bomber Force

A future bomber force that is sized to defeat a Chinese *fait accompli*, respond to a crisis in another theater, and deter nuclear attacks can only be achieved by a B-21 buy that far exceeds the “minimum of 100” often cited by the Air Force. Top Air Force leaders have indicated a need for growth beyond 100 B-21s. General Timothy Ray, former Commander of the Air Force Global Strike Command, said the Air Force must have 225 total bombers, including B-52s, to support the NDS and its single war force planning construct, and then-Chief of Staff of the Air Force General David Goldfein testified to Congress that “our assessment—and that’s been backed up by independent assessments—that a moderate risk force is 220 bombers of which 145 would be B-21s.”⁴⁶ This would be a significant improvement over today’s bomber force, but it would not provide an adequate hedge against a second war and two near-peer nuclear adversaries.

Other studies have proposed an even larger bomber force. An independent study required by the 2018 NDAA recommended the Air Force field up to 24 bomber squadrons (383 total bombers) based on its assessment of forces needed to defeat Chinese and Russian aggression nearly simultaneously.⁴⁷ Recent

	Example Future Total Inventory	Primary Mission Combat Aircraft	Adjusted for 80% Mission Capable Rates	Illustrative Weapons per Aircraft	Total Aimpoints per Day
B-21	225	161	129	40 JDAM-sized mid-range weapons	5,160
B-52	75	45	36	20 JASSM-sized stand-off weapons	720
Total	300	206	165		5,880

Table 2: Increase in potential PGMs delivered per day by a larger bomber force of penetrating B-21s. Table 2 assumes 80 percent mission-capable rates for all bombers, while actual rates may be higher or lower. Source: Mitchell Institute

studies led by the Mitchell Institute have recommended the bomber inventory should consist of at least 300 aircraft, including 225 or more B-21s.⁴⁸ This would greatly increase DOD’s daily capacity to strike fixed aimpoints and moving targets such as PLAN surface ships, amphibious assault craft, ballistic missile TELs, and mobile SAMs, as illustrated by Table 2. Other reports authored by Lt Gen David Deptula, USAF (Ret.), and Douglas Birkey recommended DOD field at least 270 bombers to meet future operational demands, and a study by Lt Gen Michael Moeller, USAF (Ret.), recommended a force of 160 combat-coded bombers, which would require the Air Force to buy more than 150 B-21s.⁴⁹

It is worth stressing that while conflict scenarios and operational assumptions underlying these assessments were not uniform, they *all* concluded the Air Force’s bomber inventory should be significantly larger and more capable of operating in contested environments. And to keep these recommendations in context, they are also less than the number of bombers the Air Force maintained for most of the Cold War, the last extended period of great power competition.⁵⁰ In other words, force design approaches that traded “capacity for capability” over the past 30 years—an outdated axiom still cited by some today—hollowed out the Air Force’s bomber force and other combat aircraft inventories. Across-the-board growth is needed to close the gap between the service’s combat air capacity and growing operational demands.

In summary, America’s bombers provide options for global strike and other missions that no other U.S. military capability can provide. These options will not be available if the force does not increase in size. The mix of stand-off and penetrating bombers will be just as critical as the total number on the ramp. Only 13 percent of U.S. bombers, 20 B-2s, can now penetrate contested areas. A balanced rebuilding approach would rapidly procure B-21s, sustain 20 B-2s until the mid-2030s to hedge against uncertainty, and ensure all bombers are maintained at the highest practical mission-capable rates. The future bomber force must be sized to deter and decisively respond to Chinese aggression, a second threat in another theater, and deter nuclear attacks—simultaneously. Three hundred bombers, including at least 225 penetrating B-21s, is a baseline requirement for the U.S. Air Force, not an overreach.

Rapidly Increasing Long-Range Strike Capacity is Also Critical to Deterrence

The dual-capable B-21 is a U.S. military pacing capability that will be key to deterring and defeating China’s efforts to impose its will on its neighbors by force. What is not as clear is how *quickly* the Air Force will acquire an operational force of B-21s to fill its long-range strike capacity gap. A full production rate of eight or nine aircraft per year would stretch out the acquisition of 100 B-21s until the late 2030s or later. A lower production rate combined with a resource-restricted force management plan that swaps out B-1s and then B-2s one-for-one with new B-21s would sustain this capacity gap even longer—perhaps until the 2040s.

There are two approaches to shortening this timeline. First, the Air Force should request additional resources to sustain its current bombers as it builds its B-21 capacity instead of swapping out old for new aircraft one-for-one. Second, the Air Force should ramp up B-21 acquisition to at least 20 per year. The combination of these two approaches would help reconstitute a long-range strike force that is better able to deter Chinese aggression later this decade—a risk that is growing—instead of some distant future.

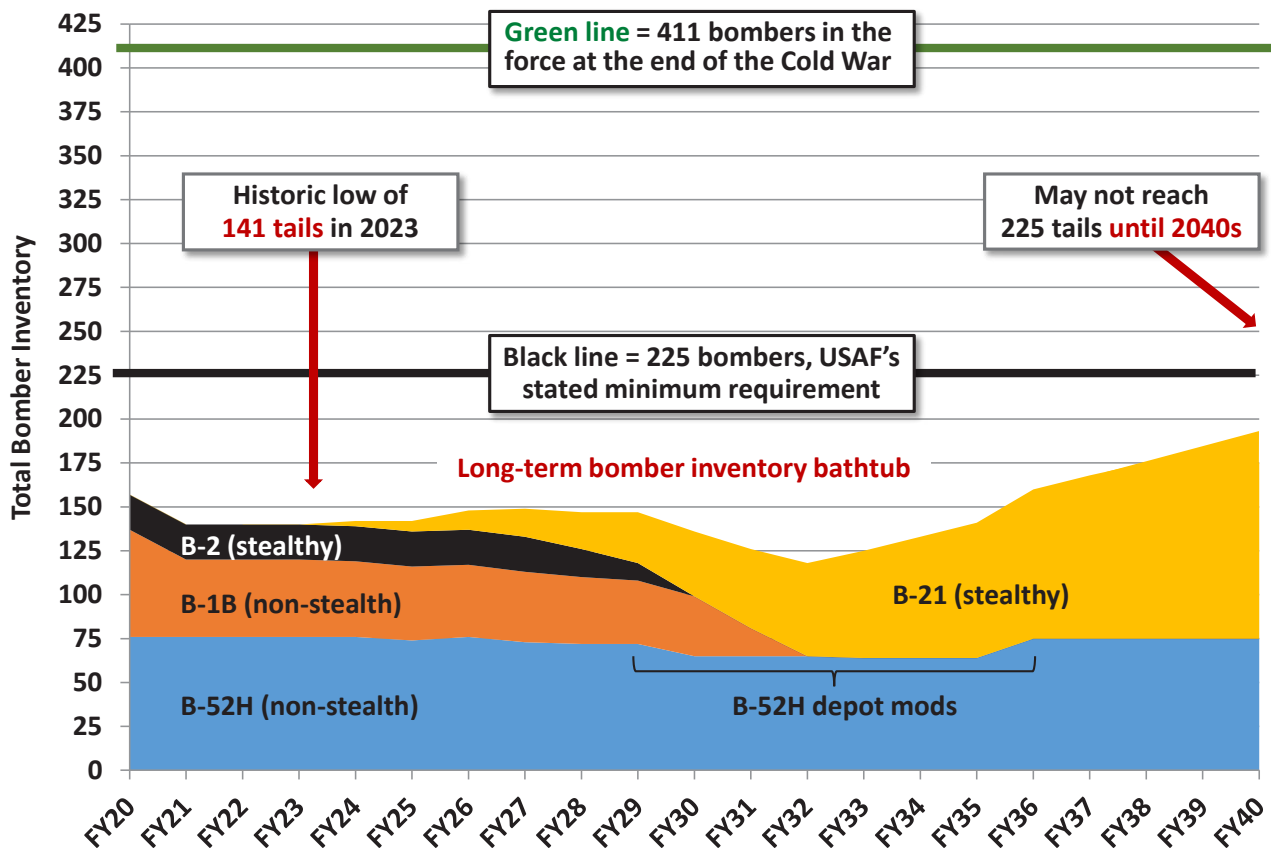


Figure 9: Mitchell Institute bomber force inventory projection assuming B-21s replace B-1s and B-2s one-for-one as planned by the Air Force.

Resource Constraints Threaten to Extend the U.S. Bomber Shortfall

The near-term outlook for increasing the size of the U.S. bomber force is not good—in fact, it could become even smaller before B-21 production increases the number of tails on the ramp. As Figure 9 illustrates, the bomber inventory could fall nearly 100 aircraft below the Air Force’s stated requirement of 225 bombers if resource shortfalls force it to retire B-1s and B-2s as new B-21s are delivered. Air Force leaders have said this one-for-one force management approach is the inevitable consequence of annual budgets that are too small.⁵¹ Personnel shortfalls are another reason. An unpublished Air Force bomber roadmap indicated the service must “harvest manpower billets from the retiring platforms” to maintain a “force-neutral manning structure.”⁵²

This is more evidence that decades of inadequate resources have created a high-risk bomber force that lacks a reserve to compensate for aircraft and aircrews lost in combat. In fact, it has diminished to the point where there are not enough bombers to compensate for peacetime accidents or long-term maintenance activities. For instance, the Air Force plans to cycle its B-52s through depot maintenance to receive new engines, upgraded avionics, a new digital backbone, and other upgrades. This will cause a “deficit in availability while those airplanes are being modified,” which means B-52s in depot maintenance will not be available for operational taskings, as illustrated in Figure 9.⁵³

Two Approaches for Reducing the Bomber Gap This Decade

Maintain current operational bombers in the force. One approach to reducing the Air Force’s bomber shortfall as quickly as possible is to keep remaining combat-capable B-1B and B-2s in the force as B-21s are delivered and reach full operational capability (FOC). This would grow the Air Force’s long-range strike capacity to deter China this decade, which is consistent with two independent 2018 NDAA-directed studies that made similar recommendations.⁵⁴ It would also require the administration and Congress to support additional funding for the Air Force if the service is to avoid the kind of “robbing Peter to pay Paul” choices imposed upon it in the past to fund critical modernization programs without commensurate budget increases. The threat is too great and too imminent to continue budget-driven practices that will further reduce its readiness and capacity for other missions.

Maximize the B-21’s acquisition rate. Maximizing B-21 acquisition as quickly as possible is another approach to reducing the Air Force’s bomber force shortfall this decade—and a more relevant timeframe to China’s military ambitions for Taiwan—instead of in some distant future. DOD leaders frequently point out that they are matching the defense budget to the NDS and not the other way around; If this is the case, the B-21’s acquisition rate should reflect this priority. Just as a “smaller but more capable” U.S. military has proven to be a broken force design approach that undermines deterrence, stretching out the acquisition of the B-21, F-35, and other advanced capabilities for the sake of near-term savings is high risk. For the United States and its allies, indecisiveness today over when, whether, and at what pace we must build the right-sized forces to counter the PLA’s growing capabilities actually increases our risk of conflict—and there will not be time to play catch-up when conflict occurs.

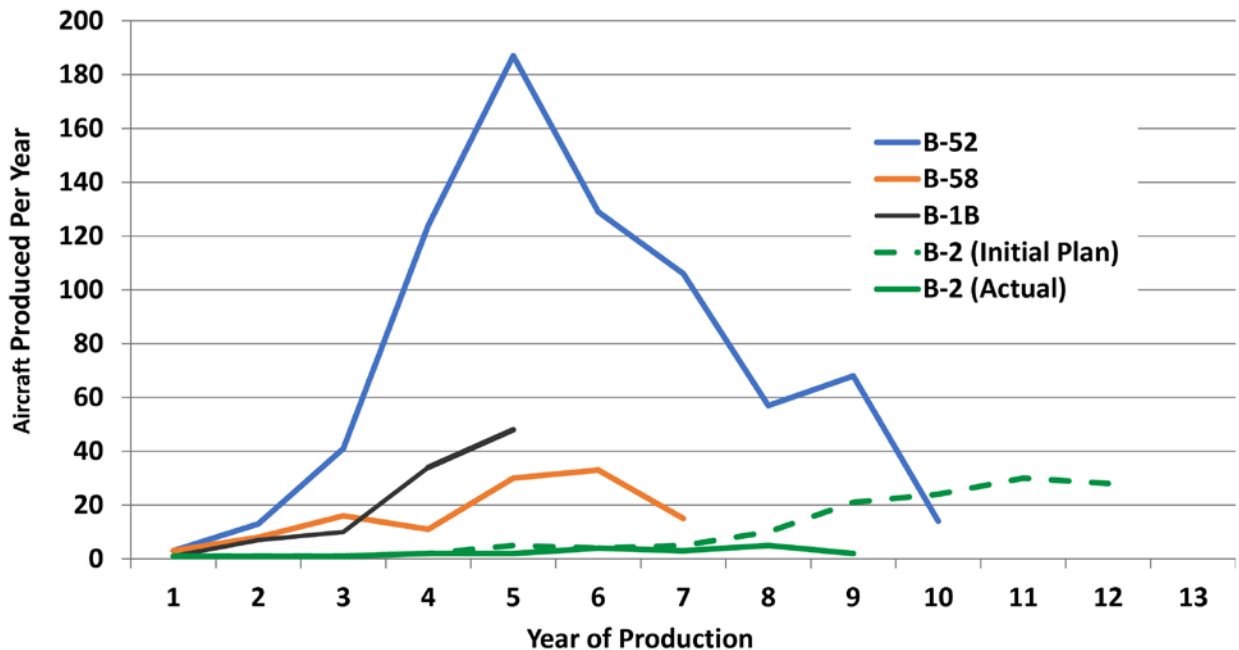


Figure 10: Acquisition rates for the Air Force’s last four bombers.

Source: Mitchell Institute; Data for B-47, B-52, and B-58 production are from Marcelle Size Knaack, *Post World War II Bombers 1945-1973* (Washington, DC: Office of Air Force History, 1988), pp. 142, 230, 241, 247, 258, 262, 269, 280, and 289. For B-1B data, see [Department of Defense Appropriations for 1984, Hearings Before the House Committee on Appropriations](#), U.S. Government Publishing Office, 1983, p. 499. For B-2 data, see United States Congress, Committee on Appropriations, [“Testimony of Hon. John J. Welch, Jr. and Lieutenant General John E. Jaquish, USAF.”](#) April 25, 1991, p. 399; and [“B-2 Production.”](#) Globalsecurity.org.

There are solid historical precedents for a full-scale production rate of 20 B-21s or more per year. The Air Force’s last four bombers were acquired within ten years or less, and except for the B-2, their delivery rate exceeded 20 bombers per year at full-scale production.⁵⁵ The Air Force’s original plan for the B-2 program was to accept delivery at an average rate of over 22 per year for the program’s last five years (see Figure 10). These rates were aligned with DOD’s Cold War objective of periodically modernizing the bomber force to ensure it would have updated technologies required to penetrate the Soviet Union’s constantly evolving air defenses.

Consider the value of a second B-21 production line. The quickest path to acquiring a larger B-21 force at a faster pace would be to stand up a second, government-sponsored production line. At an annual production rate of eight to nine B-21s on a single line, it would take over ten years to reach the Air Force’s “at least 100” inventory threshold. Production above this would require another year for every ten additional aircraft—and just less than 15 years for 145 B-21s. A second production line could reduce this timeline and improve B-21 surge production capacity. Co-locating the line with the B-21’s Programmed Depot Maintenance (PDM) facility would also create synergies between its production and sustainment operations.

Designed for Affordability: A B-21 Force Development Enabler

The public rollout of the first B-21 Raider in December 2022 demonstrated the Air Force and industry have accomplished what many thought nearly impossible: develop and deliver a new advanced military aircraft on time and on budget. Even defense acquisition skeptics appear pleasantly surprised with the B-21’s track record. In April 2021, Congressman Adam Smith, Chairman of the House Armed Services Committee and a well-informed critic of defense acquisition practices, said the B-21 program was “on time, on budget, and they’re making it work in a very intelligent way.”⁵⁶

How has this success story come to pass? From its inception as the LRS-B, the B-21 program was designed to improve the bomber’s affordability and enable its rapid acquisition at scale. Keys to these objectives include: 1) establishing cost as a key performance parameter for the new bomber; 2) developing the LRS-B as the lead element in a family of long-range strike systems; 3) taking maximum advantage of mature technologies to reduce the LRS-B’s development costs; and 4) defining capability tradeoffs that would improve the new bomber’s affordability.

- Establish cost as a key performance parameter (KPP).** DOD uses KPPs to define critical performance goals for a new capability, such as their operating speeds, payloads, and ranges. Secretary of Defense Gates mandated KPPs for the LRS-B must include an average procurement unit cost (APUC) of \$550 million or less in FY 2010 dollars for 100 aircraft.⁵⁷ This was intended to help prevent B-21 “requirements creep” and cost increases. It also served as an incentive for contractors competing for the program to avoid developing higher-risk designs and relying on immature technologies that have driven cost and schedule overruns in other programs. In other words, establishing cost as a KPP was meant to ensure the Air Force could afford to acquire B-21s at the scale needed to meet operational needs. Exceeding this cost ceiling meant the LRS-B program would be at risk of cancellation.
- Develop the B-21 as part of a family of systems for long-range strike.** The long-range strike family-of-systems concept also played a role in controlling B-21 cost growth. In part, this approach was intended to help ensure the family’s centerpiece, the LRS-B, would remain affordable. This does not mean the new bomber would be unable to perform its missions without the entire family of systems. Explained better, operating a new bomber in collaboration with a family of systems that includes aircraft capable of active

Notional Bomber Cost Comparison (FY 2010 \$)		
	50 aircraft with 40,000 lb. payloads	100 aircraft with 20,000 lb. payloads
Empty Weight	126,000 lb.	100,000 lb.
Total EMD Cost (assume 6 test aircraft)	\$19.7 billion	\$16.2 billion
Production Cost	\$24.1 billion	\$30 billion
Total Program Average Unit Cost	\$840 million	\$440 million
Total EMD and Production Costs	\$44 billion	\$46 billion

Table 3: Illustrating the potential to tradeoff some payload capacity for a larger overall force size. This comparison assumes both bomber variants have similar designs and mission systems except for payload capacity.

Source: Table 3 is derived from Mark Gunzinger, *Sustaining America’s Strategic Advantage in Long-Range Strike* (Washington, DC: Center for Strategic and Budgetary Assessments, September 2010), p. 61.

and passive sensing, electromagnetic warfare, and other tasks would increase the survivability and lethality of the Air Force's penetrating strike packages. This is not a new concept—it's how the Air Force has always operated. This force design approach has the added benefit of allowing for the insertion of new technologies into one or more elements of the family of systems, possibly without the need to integrate them into the B-21 itself. This could reduce the time and cost of modernizing the Air Force's long-range strike enterprise.

- **Leverage mature technologies to reduce B-21 program risk and cost.** DOD leadership determined the LRS-B's development must “leverage demonstrated, mature, integration-ready technologies and systems as much as possible” and “reduce complexity and technological risk by integrating only those systems necessary to provide required capability.”⁵⁸ Their intent was to reduce program risk that can result from the need to mature or invent technologies for a new bomber. This was a major lesson learned from the B-2 program, which required engineers to develop new and, in some cases, never-even-attempted technologies to meet some requirements.⁵⁹ It is not a surprise that this resulted in program delays and cost increases.
- **Make the right capability tradeoffs to improve affordability.** The Air Force and DOD defined capability tradeoffs that would increase the affordability of acquiring a larger LRS-B force. As with other combat aircraft, the cost of a new bomber is driven by requirements such as range, speed, payload capacity, mission systems, and the degree of low observability, as well as the number procured. Aircraft engineers consider tradeoffs to balance these key attributes to reduce unit costs, like trading some range to increase payload capacity or designing the aircraft to operate at speeds that achieve more efficient fuel burn rates to increase range.

An independent 2010 bomber assessment explained that trading some weapons capacity is a lower-risk approach to ensuring a new penetrating bomber's affordability, whereas the alternative would be reducing its survivability or range and mission persistence, which are critical to attacking mobile targets in contested environments.⁶⁰ Since the axiom that military aircraft are largely bought by the pound is still true, reducing a bomber's payload capacity would reduce its unit cost. Table 3 illustrates how a notional stealthy bomber with 20,000 lbs internal payload capacity could have a total program average unit cost that is roughly half the cost of a slightly larger bomber with 40,000 lbs internal payload. Another way of saying this is an estimated \$46 billion could acquire up to 100 of the 20,000 lbs payload bomber, roughly twice as many as the larger bomber. This tradeoff can also create significant operational advantages. A larger fleet of more affordable bombers would increase a theater commander's ability to attack target sets that are dispersed over large areas, sustain a continuous tempo of strikes instead of pulsing sorties, and reduce the total cost of acquiring a larger attrition reserve to compensate for combat losses.

The new bomber also promises to deliver dividends that are far more valuable than immediate program savings: most importantly, a long-range penetrating strike force that is sized and shaped to meet the challenges of DOD's pacing threat. During a visit to meet U.S. troops in Iraq in 2004, then-Secretary of Defense Donald Rumsfeld was criticized for saying, “You go to war with the army you have, not the army you might want or wish to have at a later time.”⁶¹ That was right then, and it is even more so today. Unlike the 1990s and 2000s, when DOD assumed there would be time to energize the industrial base and adapt the force to new threats when they eventually emerged, this luxury of time does not exist today. A war with China could occur with little warning, it could be violent and fast, and it could be decided in a matter of days or weeks, not months. DOD cannot wait for a national crisis to make the right decisions on the B-21's acquisition rate and other capabilities needed for peer conflict.

Conclusion and Recommendations

“When the B-21 Raider rolled out of the shadows and into public view for the first time last month, the strategic bomber instantly transmitted a tangible and unambiguous message. The batwing, stealth aircraft is a striking validation of our efforts to do whatever is necessary to protect the United States and its interests. It provides visual proof that our nation’s technical prowess remains unrivaled and that we can accelerate change and mindfully prepare to deter, meet, and blunt threats now and in the future.”

*-General C.Q. Brown, Chief of Staff of the Air Force*⁶²

The Air Force’s long-range strike bombers exist to provide weapons and sensor density at range that enable theater commanders to achieve a wide range of effects against the most difficult target sets. These effects are critical to the success of all joint force operations, not just Air Force operations in the air domain. At a global level, the United States is the only nation on the planet capable of achieving war-winning effects using long-range airpower over great distances in a matter of hours—not in weeks or months like other forces that are tied to maneuvering across the surface of the planet.

Looking ahead, the B-21 will provide a flexible, cost-effective, dual-capable means to deter and prevail against peer adversaries. Acquiring sixth-generation B-21s at scale will also restart the long-delayed process of rebuilding America’s long-range strike advantage. After years of insufficient modernization investments, the U.S. bomber fleet is now the oldest, smallest, and most fragile it has ever been. Aside from the B-2, this fleet was never designed to survive in contested areas that characterize high-end peer conflicts. Fortunately, after the B-2 program ended, the Air Force and its defense industry partners continued to develop the next generation of radar-absorbing materials, advanced computing power, and other stealth technologies. These will ensure B-21s are able to operate in all threat environments well into the future. Fifth-generation F-22 and F-35 fighters are prime examples of the continuing technological advances that produce dominant capabilities for U.S. warfighters—and the B-21 is the next step in this evolution.

The need for the B-21’s survivability, range, and payload capacity has never been greater. Adversary A2/AD capabilities continue to mature and proliferate widely, especially in the Indo-Pacific and along NATO’s eastern frontier. The B-21 and B-2 will be the only U.S. weapon systems with the ability to penetrate these advanced air defenses to hold peer adversaries’ highest-value targets at risk. These include targets that restrict the freedom of U.S. forces to rapidly seize and maintain the initiative, which history has shown as critical to prevailing in conflict. No other capability in the U.S. military’s inventory can match the ability of the Air Force’s bomber force to deter and defeat peer adversary aggression. A future fleet of 300 or more bombers—including existing B-52s and at least 225 penetrating B-21s—will provide the capacity required

to deter nuclear attacks, defeat peer aggression in one or more theaters, and hedge against attrition in war. Multiple independent studies agree with this need for a future bomber force design that grows the combat inventory to meet operational demand and provide the capacity to conduct cost-effective, war-winning penetrating strike operations.

Recommendations

Based on this assessment and a mature body of evidence from related studies, the Mitchell Institute offers the following recommendations:

- 1. DOD should increase the range and payload capacity of its strike forces for peer conflicts.** DOD's past decisions to retire two-thirds of its bombers created a combat aircraft inventory that is now over-balanced toward shorter-range fighter/attack aircraft. While this force was barely adequate for post-Cold War conflicts with lesser regional adversaries and campaigns to support counterterrorism and counterinsurgency operations, DOD now requires much greater long-range strike capacity to defeat Chinese aggression in the Indo-Pacific and deter other threats as directed by the *U.S. National Defense Strategy*.
- 2. A total force of more than 300 bombers including 225 stealthy aircraft is needed to provide the penetrating strike capacity needed to defeat peer aggression.** Many targets in a campaign to counter a Chinese *fait accompli* attempt will be highly mobile, which degrades the effectiveness of long-range stand-off strikes. In fact, overwhelming strikes to rapidly attrit warships, armored vehicles, missile transporter-erector-launchers (TELS), and other PLA offensive weapons will be critical to defeating a Chinese invasion of Taiwan and aggression elsewhere around the world. Long-range weapons also typically lack warheads large enough to defeat very hard or deeply buried shelters, C2 centers, and weapons storage bunkers, many of which could be located deep in China's interior. Multiple analyses of these and other strike requirements are why DOD decided that it must increase the capacity of its bomber force and rebalance its mix toward penetrating B-21s.⁶³
- 3. Developing a force capable of conducting long-range strikes at scale will require DOD to prioritize cost-effective capabilities.** Defeating a Chinese invasion of Taiwan or another area it seeks to dominate may require U.S. forces to strike 100,000 or more aimpoints. This means DOD must consider the cost-effectiveness of its long-range strike forces. One-time-use missiles launched from stand-off ranges require propulsion units, fuel, guidance systems, and other capabilities to reach and then accurately strike their designated aimpoints. These features make stand-off weapons more expensive—in some cases by double-digit millions of dollars—than smaller, shorter-range PGMs that can be carried into contested areas by penetrating bombers to attack the same targets. Simpler munitions with modular components shared across weapon types carried by penetrating bombers would also improve industry's ability to quickly produce them at scale, which is an attribute highlighted by the urgent operational needs of Ukraine as it seeks to repel invading Russian forces today. Stand-off strike platforms also require target cues from off-board sensors, secure datalinks, fire control systems, and other capabilities that increase the complexity of their kill chains. Forward posturing large footprint strike systems like ground-based missile launchers will require host nation basing consent and must be completed well in advance of their use because of the enormity of their transportation requirements and the time needed to transport and stand up their systems. DOD

analyses that have considered these and other factors have repeatedly concluded that penetrating bombers capable of organically finding, tracking, and attacking multiple aimpoints per sortie are the more cost-effective means of striking large target sets over long ranges in contested areas.

4. **A larger bomber force would be the most cost-effective means to deter two peer nuclear adversaries.** Today, Russia's nuclear forces are more modernized than the U.S. triad, and China is in a strategic breakout, meaning it is increasing the size and capabilities of its nuclear triad to reach or exceed parity with the U.S. triad. Only the expansion of the dual-capable B-21 force offers a "two-for-one" cost-benefit with the potential to offset the growing threat from two near-peer nuclear adversaries and hedge against uncertainty across the conflict spectrum. Strategic deterrence is no longer an academic notion; it is once again a national imperative. U.S. leaders may have preferred a different path for the nuclear triad, but America's adversaries have spoken, and ignoring the reality of their actions could have existential consequences.
5. **A robust, faster B-21 acquisition rate is critical to deterring Chinese aggression.** U.S. national security leaders have warned the PLA may be prepared to forcibly reunify Taiwan with the Chinese mainland later this decade. This timeline coincides with the Air Force reaching an all-time low in the size of its bomber and fighter forces due to inadequate budgets. Mitchell Institute has previously recommended accelerating the Air Force's acquisition of advanced munitions, F-35A fighters, and uninhabited collaborative combat aircraft (CCA) to reduce this risk. The same reasoning requires the U.S. Air Force to maximize the B-21's acquisition rate. The Air Force must be wary of a "buy to budget" approach—which means buying the number of B-21s the Air Force's existing budget can afford and not advocating for the budget to buy what is needed. Throttling B-21 acquisition to achieve short-term budget savings will increase program costs in the long run and, more importantly, increase the risk of a conflict with an opportunistic China that would result in costs that exceed any temporary program savings.

In conclusion, the *2022 U.S. National Defense Strategy* requires the services to create force designs and prioritize resources to prevail in great power competition and conflict. These priorities must include developing the next generation of strike systems that provide theater commanders with the range, capacity, and precision they need to defeat peer aggression and then sustain operations to secure the peace. This, plus deterring nuclear attacks against the United States, is the purpose of the U.S. bomber force.

Today, this force falls short of having the penetrating strike capacity needed to meet these challenges. Thirty years of successive inventory cuts, combined with the failure to modernize the fleet since the Cold War's end, are the reasons the U.S. bomber force is now primarily a stand-off force that cannot penetrate contested areas. The B-21 offers a once-in-a-generation opportunity to correct these shortfalls. A force of 225 or more B-21s will have the capacity needed to penetrate defended areas and deliver weapon payloads at scale on all types of targets. This is a means of negating our adversaries' best efforts over the past three decades to overcome America's precision strike advantages. The challenge to realizing this force design is not a matter of technological uncertainty or developmental risks—the unfortunate hallmark of other DOD weapon system programs. The challenge is resources. With sufficient funding, the Air Force could maximize B-21 production and field a penetrating strike deterrent this decade, not in some distant future. An acquisition approach that buys to budget instead of what is needed will be a prescription for increased risk for a decade or more. It is critical to remember that while the cost of deterrence can be high, the cost of failing to deter is invariably far more expensive. ★

Endnotes

- 1 U.S. Department of Defense, *2022 National Defense Strategy of The United States of America* (Washington, DC: DOD, October 27, 2022).
- 2 The Air Force and independent think tanks have completed recent studies that recommended reconstituting a larger bomber force. See Mark Gunzinger, Carl Rehberg, and Lukas Autenried, *Five Priorities for the Air Force's Future Combat Air Force* (Washington, DC: Center for Strategic and Budgetary Assessments, 2020); U.S. Air Force, *Fiscal Year 2018 NDAA Section 1064 Study: Aircraft Inventories for the Air Force* (Washington, DC: U.S. Air Force, March 2019); MITRE, *U.S. Air Force Aircraft Inventory Study Executive Summary* (McLean, VA: MITRE, 2019); Mark Gunzinger et al., *An Air Force for an Era of Great Power Competition* (Washington, DC: Center for Strategic and Budgetary Assessments, and Budgetary Assessments, 2019); David A. Deptula and Douglas A. Birkey, *Building the Future Bomber Force America Needs: The Bomber Re-Vector* (Arlington, VA: Mitchell Institute for Aerospace Studies, September 2018); Michael R. Moeller, *U.S. Bomber Force: Sized to Sustain an Asymmetric Advantage for America* (Arlington, VA: Mitchell Institute, 2015).
- 3 While the Obama Administration's "rebalance" or "pivot" to the Asia-Pacific took many political and diplomatic steps toward strengthening our alliances in the region, it failed to follow up with needed military investments, procurements, and modernization programs. See "Fact Sheet: Advancing the Rebalance to Asia and the Pacific," White House Press Secretary, November 16, 2015.
- 4 DOD, *Summary of the 2018 National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge* (Washington, DC: DOD, January 19, 2018).
- 5 China believed decisive operations conducted by U.S. forces equipped with advanced sensors, precision guided munitions (PGM), stealth aircraft, and communication networks in Desert Storm signaled a "profound shift in the character of modern warfare." This led to a massive Chinese effort to transform the PLA to conduct what it calls "informationized warfare," even as DOD downsized its forces and cancelled modernization programs. Quotes from Michael Dahm, "China's Desert Storm Education," *U.S. Naval Institute Proceedings*, March 2021.
- 6 David A. Ochmanek, *Determining the Military Capabilities Most Needed to Counter China and Russia: A Strategy-Driven Approach* (Arlington, VA: RAND Corporation, June 2022), p. 6. According to former Deputy Assistant Secretary of Defense Elbridge A. Colby, principal author of the 2018 National Defense Strategy, "Our forces must be exceptionally lethal and capable, optimized to defeat China or Russia. At the same time, however, wars with China or Russia must remain limited because the alternative is apocalypse, which neither side wants—thus we must plan and prepare for them as limited wars. Above all, this requires focusing on defeating the other side's theory of victory, and particularly the *fait accompli* strategy." Elbridge A. Colby, *Testimony before the Senate Armed Services Committee on "Implementation of the National Defense Strategy,"* January 29, 2019, p. 5.
- 7 Justin Bronk, *Russian and Chinese Combat Air Trends: Current Capabilities and Future Threat Outlook* (London, UK: Royal United Services Institute, October 30, 2020), p. v.
- 8 During testimony to Congress last year on China's nuclear build-up, General Anthony Cotton, Commander, Air Force Global Strike Command, said, "We have seen the incredible expansiveness of what they're doing with their nuclear force—which does not, in my opinion, reflect minimal deterrence. They have a bona fide triad now." Karoun Demirjian, "U.S. general warns of China's expanding nuclear arsenal," *The Washington Post*, September 15, 2022. Quote from General Anthony Cotton, Commander of U.S. Strategic Command, *SASC Fiscal Year 2024 U.S. Strategic Command and U.S. Space Command Posture Hearing*, testimony to the Senate Armed Services Committee, March 3, 2023.
- 9 U.S. Department of Defense, *2022 National Defense Strategy* (Arlington, VA: DOD, October 27, 2022), p. 4; and Office of the Secretary of Defense (OSD), *Military and Security Developments Involving the People's Republic of China 2022*, Annual Report to Congress (Arlington, VA: DOD, November, 2022), p. 37.
- 10 For more on carrier air wing limitations and the outer air battle, see Bryan Clark and Timothy A. Walton, *Regaining the High Ground Against China: A Plan to Achieve U.S. Naval Aviation Superiority This Decade* (Washington, DC: Center for Defense Concepts and Technology, Hudson Institute, April 2022).
- 11 For a summary of this budget trend, see David A. Deptula and Mark A. Gunzinger, *Decades of Air Force Underfunding Threaten America's Ability to Win* (Arlington, VA: Mitchell Institute for Aerospace Studies, September 12, 2022).

- 12 DOD includes a force planning construct as part of its *National Defense Strategy* that provides guidance on the type, number, and frequency of major conflict scenarios and other assumptions the services must use to size their forces. Planning around these most likely and other threat scenarios is exactly how DOD, Mitchell experts, and other professionals in the national security sphere arrived at these bomber force numbers. For more info, see Mark Gunzinger, *Long-Range Strike: Resetting the Balance of Stand-in and Stand-off Forces* (Arlington, VA: Mitchell Institute for Aerospace Studies, September 2020); U.S. Senate Armed Services Committee, hearing on “Posture of the Department of the Air Force,” March 3, 2020; Gunzinger, Rehberg, and Autenried, *Five Priorities for the Air Force’s Future Combat Air Force*; U.S. Air Force, *Fiscal Year 2018 NDAA Section 1064 Study*; MITRE, *U.S. Air Force Aircraft Inventory Study Executive Summary*; Gunzinger et al., *An Air Force for an Era of Great Power Competition*; Deptula and Birkey, *Building the Future Bomber Force America Needs*; and Moeller, *U.S. Bomber Force*.
- 13 On January 16–17, 1991, seven B-52G crews flew 35-hour “round robin” missions from Barksdale AFB and launched 35 Conventional Air-Launched Cruise Missiles (CALCMs) against high-value targets located throughout Iraq. Benjamin Raughton, “Desert Storm: 2nd Bomb Wing leads the air war.” 2nd Bomb Wing Public Affairs, January 14, 2016.
- 14 For more on these force cuts, see Deptula and Gunzinger, *Decades of Air Force Underfunding Threaten America’s Ability to Win*.
- 15 “President George H.W. Bush’s Address Before A Joint Session Of The Congress On The State Of The Union.” *C-SPAN*, January 28, 1992.
- 16 Secretary of Defense William S. Cohen, *Report of the Quadrennial Defense Review* (Arlington, VA: DOD, May 1997), p. 46.
- 17 Ibid.
- 18 OSD, *2006 Quadrennial Defense Review Report* (Washington, DC: DOD, February 6, 2006), p. 46.
- 19 J.J. Gertler, *Air Force B-21 Raider Long-Range Strike Bomber* (Washington, DC: Congressional Research Service [CRS], September 22, 2021), pp. 2–3.
- 20 Office of Management and Budget (OMB), *Terminations, Reductions, and Savings, Budget of the U.S. Government, Fiscal Year 2010* (Washington, DC: OMB, 2009), p. 44.
- 21 Commission on the Roles and Missions of the Armed Forces (CORM), “Future Bomber Force Report,” unpublished supporting study, 1995. For more, see Brent Scowcroft, *Scowcroft Independent Bomber Force Review* (Washington, DC: Collins Group Int., June 23, 1997).
- 22 See Joseph Trevithick, “B-1B Bomber’s New Ultra Long-Range Focus Hints At Future B-21 Ops.” *The Drive*, December 14, 2022.
- 23 General Ray made this comment during the Air & Space Force Association’s Air, Space, and Cyber Conference in 2021. Barry Rosenberg, “The B-21 Raider: A Marvel Of Digital Development.” *Breaking Defense*, May 5, 2021.
- 24 Defense Intelligence Agency (DIA), *2022 Challenges to Security in Space* (Washington, DC: DIA, March 2022), p. 9. DIA referenced Kevin Pollpeter et al., *China Dream, Space Dream—China’s Progress in Space Technologies and Implications for the United States* (Washington, DC: U.S.-China Economic and Security Review Commission, March 2, 2015), p. iv; and OSD, *Military and Security Developments Involving the People’s Republic of China 2018*, Annual Report to Congress (Washington, DC: DOD, May 16, 2018), pp. 72, 74.
- 25 As cited in DIA, *2022 Challenges to Security in Space*, p. 9. DIA referenced Chang Long, “Grasp the Trend of New Military Changes—Review and Prospect from the Gulf War to the Iraq War,” *解放军报 (PLA Daily)*, October 28, 2003.
- 26 The Long-Range Hypersonic Weapon (LRHW) pairs a rocket booster with a payload-carrying hypersonic glide body that separates from its booster after reaching high altitudes and hypersonic speeds and then glides to its target over a dynamic, non-ballistic flight path. LRHWs could have a range over 1,725 miles and cost \$40 million or more each depending on the cost of their booster stack and hypersonic glide vehicle. See Kelley M. Saylor, *Hypersonic Weapons: Background and Issues for Congress* (Washington, DC: CRS, October 27, 2022), pp. 6–7.
- 27 SIAWs will be carried internally by stealth aircraft for strikes against rapidly relocatable targets such as “Theater Ballistic Missile Launchers, Land Attack and Anti-Ship Cruise Missile Launchers, GPS Jammers, Anti-Satellite Systems, and Integrated Air Defense Systems.” DOD, *Fiscal Year 2023 Budget Estimates, Air Force Justification Book, Volume 1 of 1, Missile Procurement, Air Force* (Washington, DC: DOD, April 2022), p. 105. The cost per SIAW weapon is contingent on mass purchasing quantity: higher quantities reduce the units costs. In the Air Force Justification Book, the \$1.3 million per weapon is based on years when over 100 weapons are procured.
- 28 John A. Tirpak, “Northrop Grumman Offers New B-21 Raider Details Ahead of Rollout.” *Air & Space Forces Magazine*, November 29, 2022. Also see “B-21 Raider.” U.S. Air Force fact sheet.

29 For an analysis on ACPs, see Caitlin Lee and Mark Gunzinger, *The Next Frontier: UAVs for Great Power Conflict, Part 1, Penetrating Strike* (Arlington, VA: Mitchell Institute for Aerospace Studies, December 2022).

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31 C. Todd Lopez, “World Gets First Look at B-21 Raider,” *DOD News*, December 3, 2022.

32 Jim Garamone, “Concept of Integrated Deterrence Will Be Key to National Defense Strategy, DOD Official Says,” *DOD News*, December 8, 2021.

33 See David A. Shlapak et al., *A Question of Balance: Political Context and Military Aspects of the China-Taiwan Dispute* (Santa Monica, CA: RAND Corporation, 2009), as quoted in David A. Ochmanek, *Determining the Military Capabilities Most Needed to Counter China and Russia: A Strategy-Driven Approach* (Santa Monica, CA: RAND Corporation, June 2022), p. 6.

34 Ochmanek, *Determining the Military Capabilities Most Needed to Counter China and Russia*, p. 10.

35 “DAF must be prepared to efficiently engage air, land, and sea surface moving targets in the numbers or on the time scale it would face during any potential conflict with a well-resourced peer- or near-peer adversary attempting an act of aggression.” Maj Gen Anthony Genatempo, Air Force Program Executive Officer, Command, Control, Communications, Intelligence, & Networks Directorate, Air Force Materiel Command, “Network Capabilities Enabling Moving Targets,” November 1, 2022, briefing to the NDIA 48th Annual Air Armament Symposium, slides 8–9.

36 Lopez, “World Gets First Look at B-21 Raider.”

37 John Venable, “2023 Index of U.S. Military Strength: U.S. Air Force,” *2023 Index of U.S. Military Strength*, Heritage Foundation, October 18, 2022.

38 Oriana Pawlyk, “Overtasking of B-1 Lancer Fleet Led to Faster Deterioration, General Says,” *Military.com*, April 17, 2019. According to General David Goldfein, then-Air Force Chief of Staff, “We put stresses on the aircraft that we did not anticipate... we’re seeing significant structural issues with the B-1.” John A. Tirpak, “Goldfein Forecasts B-1 Cuts, More B-21s,” *Air Force Magazine*, September 17, 2019.

39 John A. Tirpak, “USAF to Retire B-1, B-2 in Early 2030s as B-21 Comes On-Line,” *Air Force Magazine*, February 9, 2018.

40 Eric Edelman and Gary Roughead, *Providing for the Common Defense: The Assessment and Recommendations of the National Defense Strategy Commission* (Washington, DC: U.S. Institute of Peace, 2018), p. vi.

41 Deputy Assistant Secretary for Industrial Base Resilience Halimah Najieb-Locke, quoted in Doug Cameron, “Lagging Arms Production Makes Pentagon Wary of Further Industry Consolidation,” *The Wall Street Journal*, January 3, 2023.

42 U.S. Department of State, “New START Treaty,” fact sheet, current as of February 16, 2023. Notably, Russia announced it will suspend its participation in the treaty in February 2023, though claims it will still adhere to the limits. See Mark Trevelyan and Jake Cordell, “Russia says it will play by nuclear treaty rules despite suspending deal with U.S.,” *Reuters*, February 22, 2023.

43 Amy F. Woolf, *Russia’s Nuclear Weapons: Doctrine, Forces, and Modernization* (Washington, DC: CRS, April 21, 2002), p. 21.

44 Admiral Chas Richard, Commander of U.S. Strategic Command, and General James Dickinson, Commander of U.S. Space Command, *testimony on United States Strategic Command and United States Space Command in review of the Defense Authorization Request for Fiscal Year 2023 and the future years defense program*, Senate Armed Services Committee, March 8, 2022, p. 69.

45 *Ibid.*, pp. 28–29.

46 Colin Clark, “More B-21s Likely: B-1s to Carry Up to 8 Hypersonic Weapons,” *Breaking Defense*, September 17, 2019. Goldfein’s comment is from a recording of a Senate Armed Services Committee hearing. See “Posture of the Department of the Air Force.”

47 CSBA’s study recommended a future force of 383 TAI bombers consisting of 20 B-2s, 75 B-52Hs, and 288 B-21s, which translates to 266 PMAI bombers that are fully resourced to support operations. Gunzinger, Rehberg, and Autenried, *Five Priorities for the Air Force’s Future Combat Air Force*.

48 Gunzinger, *Long-Range Strike: Resetting the Balance of Stand-in and Stand-off Forces*.

49 Deptula and Birkey, *Building the Future Bomber Force America Needs*, p. 1; and Moeller, *U.S. Bomber Force*. Combat-coded aircraft are those containing full equipment and capabilities, maintained to be fully ready, and not designated for training or other purposes. Sixteen of the Air Force’s 20 B-2s are combat-coded aircraft.

50 The Air Force had 96 TAI B-1Bs, 254 TAI B-52s, and 61 TAI FB-111s in FY 1988. James C. Ruehrmund Jr. and Christopher J. Bowie, *Arsenal of Airpower: USAF Aircraft Inventory 1950–2016* (Arlington, VA: Mitchell Institute for Aerospace Studies, February 2018), p. 22.

51 According to the Air Force, keeping B-1s and B-2s on the ramp as B-21s are delivered “is not affordable... the B-1 and B-2, as phenomenal as they are, we’ve got to get those out of service as the B-21 comes on and we get ourselves to that two-bomber fleet, which is a B-21 and a modernized B-52.” Brian W. Everstine, “[Progress on B-21 Means Current Bombers Need a Fast Retirement](#),” *Air Force Magazine*, July 15, 2021.

52 Tirpak, “[USAF to Retire B-1, B-2 in Early 2030s as B-21 Comes On-Line](#).”

53 Everstine, “[Progress on B-21 Means Current Bombers Need a Fast Retirement](#).”

54 Two parallel independent studies directed by 2018 National Defense Authorization Act were completed by the MITRE Corporation and the Center for Strategic and Budgetary Assessments (CSBA). MITRE’s recommended keeping all B-1Bs and B-2s in the active inventory until 50 operational B-21s were available. CSBA’s made a similar recommendation to Congress. See MITRE, [U.S. Air Force Aircraft Inventory Study Executive Summary](#); and Gunzinger et al., [An Air Force for an Era of Great Power Competition](#).

55 The original B-2 bomber acquisition program was intended to reach a maximum production rate of 30 aircraft per year.

56 Paul McLeary, “[HASC Chair: B-21 a Good News Story](#),” *Breaking Defense*, April 23, 2021.

57 APUC is calculated by defining the total amount spent on procurement by the number of items procured. B-21 procurement costs include the cost of the aircraft itself (all the hardware and all software installed on it), support items, and initial spares and repair parts. In 2010, then-Secretary of Defense Gates set an affordability target for total B-21 procurement spending of \$55 billion dollars (measured in 2010 dollars). Dividing this figure by a quantity requirement of 100 aircraft yields a unit cost of \$550 million dollars in base year 2010 dollars. APUC therefore represents the average cost of procuring the B-21 and its related support equipment when 100 aircraft are purchased.

58 Comptroller General of the United States, [decision on The Boeing Company, B-412442](#), U.S. Government Accountability Office, February 16, 2016, p. 3.

59 The B-2’s engineers were able to pull this off by accomplishing what they called “a miracle a day.”

60 See Mark Gunzinger, [Sustaining America’s Strategic Advantage in Long-Range Strike](#) (Washington, DC: Center for Strategic and Budgetary Assessments, September 2010).

61 Eric Schmitt, “[Iraq-Bound Troops Confront Rumsfeld Over Lack of Armor](#),” *New York Times*, December 8, 2004.

62 General C.Q. Brown, Jr., “[The B-21 Raider is the right capability at the right time](#),” *The Hill*, January 13, 2023.

63 DOD includes a force planning construct as part of its *National Defense Strategy* that provides guidance on the type, number, and frequency of major conflict scenarios and other assumptions the services must use to size their forces. Planning around these most likely and other threat scenarios is exactly how DOD, Mitchell experts, and other professionals in the national security sphere arrived at these bomber force numbers. For more info, see Gunzinger, [Long-Range Strike: Resetting the Balance of Stand-in and Stand-off Forces](#); “[Posture of the Department of the Air Force](#)”; Gunzinger, Rehberg, and Autenried, [Five Priorities for the Air Force’s Future Combat Air Force](#); U.S. Air Force, [Fiscal Year 2018 NDAA Section 1064 Study](#); MITRE, [U.S. Air Force Aircraft Inventory Study Executive Summary](#); Gunzinger et al., [An Air Force for an Era of Great Power Competition](#); Deptula and Birkey, [Building the Future Bomber Force America Needs](#); Moeller, [U.S. Bomber Force](#).



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