



BUILDING THE FUTURE BOMBER FORCE AMERICA NEEDS:

The Bomber Re-Vector

By Lt Gen David A. Deptula, USAF (Ret.)
and Douglas A. Birkey





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The Mitchell Institute for Aerospace Studies

Air Force Association

Arlington, VA

September 2018

About the Mitchell Institute for Aerospace Studies

The Mitchell Institute for Aerospace Studies is an independent, nonpartisan policy research institute established to promote understanding of the national security advantages of exploiting the domains of air, space, and cyberspace. The Mitchell Institute's goals are: 1) educating the public about the advantages of aerospace power in achieving America's global interests; 2) informing key decision makers about the policy options created by exploiting the domains of air, space, and cyberspace, and the importance of necessary investment to keep America the world's premier aerospace nation; and 3) cultivating future policy leaders who understand the advantages of operating in air, space, and cyberspace. Mitchell Institute maintains a policy not to advocate for specific proprietary systems or specific companies in its research and study efforts.

About the Authors

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Deptula holds a B.A. in astronomy and an M.S. in systems engineering—both from the University of Virginia. He also holds an M.S. in national security strategy from the National War College at Fort McNair, Washington, DC. Deptula is a prolific author on aerospace power, and is a thought leader on national defense, strategy, and ISR matters.

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Foreword

The growing gap between mission capacity and real-world demand is felt in nearly every single Air Force mission set today. A post-Cold War draw-down, a nearly two-decade focus on low intensity operations, the 2011 Budget Control Act-directed cuts, numerous continuing resolutions, and other factors saw Air Force capabilities and capacity reduced over the last quarter century.

No mission area exemplifies this struggle better than airborne long-range strike. At the end of the Cold War, B-2 acquisition was cut from 132 airframes to 21. Entire aircraft fleets, like the FB-111, were retired and remaining inventories of B-1Bs and B-52s were cut by over half. In addition, readiness levels for the legacy force of B-1Bs, B-2s, and B-52s have suffered thanks to funding shortfalls. At the same time, the Air Force has faced a surge in demand for bombers. They have been used in every post-Cold War conflict going back to Operation Desert Storm and have proved vital to deterring adversaries. It is no mistake that bomber deployments are a frequent response to antagonistic actions by Russia, China, North Korea, and other potential adversaries. Their presence is an unmistakable signal of American resolve.

With the global threat environment growing more severe, demand for bomber capabilities is on the rise. As one Air Force official recently explained: “In the last five years, Air Force Global Strike Command has gone from supporting one enduring combatant commander requirement to an average of 12 annually, a 1,100-percent increase.” Despite surging demand, the Air Force presently operates the smallest bomber fleet it has fielded since 1947—157 aircraft. The Mitchell Institute is not alone in highlighting this capacity gap. Just prior to this report’s completion, The RAND Corporation released a study, titled *Is the USAF Flying Force Large Enough?* which assessed that bombers were one of the highest risk mission areas due to a shortfall in available aircraft.

While all of this paints a stark picture, the good news is that a pathway exists for the Air Force to grow its bomber force. With the production of the B-21 slated to begin in the next few years, the service can grow its bomber force. This will require retaining and modernizing the B-1B, B-2, and B-52, with B-21s procured additively. The Mitchell Institute believes a realistic inventory goal for the Air Force bomber force is 270 aircraft.

It is time for the country to realize that present security circumstances are growing increasingly grave. These developments demand bomber capabilities and capacity be driven by real-world factors, not constrained force structure driven by budget spreadsheets. The policy options afforded by bombers are fundamentally unique and cannot be replicated by other tools within the Department of Defense inventory. It is time to recognize these facts and align the bomber force structure accordingly.



Lt Gen David A. Deptula, USAF (Ret.)
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September 6, 2018

Executive Summary

The United States faces an inflection point with respect to power projection in an increasingly dangerous, contested, and complex security environment. Ever since the end of the Cold War, Americans have assumed their nation possessed military superiority, no matter the situation. However, the actions of multiple competing nations are steadily eroding this advantage.

China and Russia are concurrently developing strategies and fielding advanced capabilities specially designed to counter US combat power. Emboldened, these countries are using their enhanced militaries to underwrite strategies that challenge US interests around the globe. At the lower end of the threat spectrum, continued instability in regions like the Middle East continues to tax defense resources. The combined effect of increasingly lethal threats paired with a steady state demand for continued low intensity combat operations sees American military power stretched ever thinner.

With adversaries aggressively pushing forward, the Air Force must rapidly realign its capabilities and capacity with a requirements-driven force, not one shaped unduly by arbitrary budget targets. Rather than just buying more of what the service already has, the United States needs the right balance of capabilities to ensure leaders are empowered by policy options that best serve the nation.

With adversaries aggressively pushing forward, the Air Force must rapidly realign its capabilities and capacity with a requirements-driven force, not one shaped unduly by arbitrary budget targets.

To this end, long-range sensor-shooter aircraft, historically known as bombers, will become an increasingly important military tool thanks to five distinct attributes:

- 1. Range** is important for two key reasons. First, it allows the bomber force to strike nearly any target no matter its distance. Many key facilities lie deep within potential adversary territory, with bombers being one of the few assets capable of reaching these targets early in a conflict. Second, range enhances survivability by permitting the bomber force to operate from bases beyond the reach of adversary anti-access capabilities and lessens reliance on tankers.
- 2. Responsiveness** means the bomber force can react quickly to emerging crises around the globe. Unlike other elements of the US military, the response time of bombers is measured in hours—not days, weeks, or even months, as other forces require. Furthermore, these aircraft can move easily from one theater to another, potentially from the same base. This strategic flexibility makes them exceptionally useful in an uncertain, multi-polar world.
- 3. Payload** gives the bomber force the ability to bring a large number of weapons and highly specialized capabilities into a fight. This includes swarms of cheap munitions to swamp adversary air defenses, specialized penetrators to defeat deeply buried targets, powerful sensors to better understand the battlespace, and potentially non-kinetic payloads that support integrated systems destruction warfare.

4. **Survivability** permits bombers to prudently and decisively attain effects regardless of threat. Aircraft that feature stealth technology, like the B-2 and eventually the B-21, can strike targets anytime, anywhere. Non-stealth aircraft like the B-1B and B-52 complicate an enemy's defensive calculus at the high end of the threat spectrum by using standoff missile capabilities coupled with intelligence, surveillance, and reconnaissance (ISR), to locate targets. The combination of these aspects of survivability imposes costs upon an enemy and radically complicates their defense strategy.
5. **Versatility** is also a critical attribute, since all bombers regardless of type now execute missions that extend far past their traditional roles as long-range air-to-ground strategic attack and interdiction strike aircraft. Additional mission capabilities include counter sea attack, ISR, persistent direct attack, close air support, and electronic warfare. Future mission growth includes capability in the deployed airborne decentralized command and control mission set as integral elements of the combat cloud, the ability to integrate new technologies such as hypersonic and directed energy weapons, cyber weapons, and potentially counter-air systems.

Retirement of the Air Force's legacy bomber aircraft should be postponed until sufficient fully mission-capable B-21s have been produced and delivered to equip a significantly expanded bomber force.

Clearly, the current force of 157 bombers is not enough to meet America's defense requirements. The present inventory is smaller than one deemed necessary in the mid-1990s when the United States stood as the world's sole superpower, and the globe was a far safer place. Today's bomber force is the smallest the Air Force has ever possessed and is the result of emphasis on budget restrictions, to the exclusion of real-world security demands. The modern threat environment demands that the Air Force build a force with range, responsiveness, payload, survivability, and versatile combat power as keystone attributes. This force must be able to address concurrent large-scale conflicts and persistent steady-state demands.

These considerations and insights inform a series of recommendations articulated in this study, designed to increase US long-range strike aircraft capability and capacity:

1. **B-21 Acquisition:** The Air Force should aim to procure at least 180 B-21s at an increased production rate to meet growing demand for penetrating strike capability and provide highly survivable long-range sensor-shooter platforms to support a variety of emerging missions.
2. **Bomber Retirements:** To build the force structure needed for the 21st century, the Air Force should consider retaining and modernizing its legacy force of B-1Bs and B-2s. Retirement of these legacy bomber aircraft should be postponed until sufficient fully mission-capable B-21s have been produced and delivered to equip a significantly expanded bomber force. This additive approach, in combination with the stated intent to retain and modernize the B-52, builds the bomber inventory, closing the gap between demand and available assets in an era when range, responsiveness, payload, survivability, and versatility matter more than ever.

3. **Modernization:** All legacy bomber variants should be modernized to afford continued operational relevance for several more decades and to take advantage of the considerable percentage of lifespan remaining in the B-1B, B-2, and B-52.
4. **Fleet Management:** To make retirement pronouncements today about decisions that will be made in the 2030s is counterproductive. Once an aircraft is labeled for retirement, modernization dollars disappear. When circumstances change and an aircraft's service life is extended, a surge of funding is required to bring the enterprise back up to a full operational level and vital modernization efforts may get out prioritized. This overly prescriptive approach to fleet management is not only expensive, but also highly inefficient. Air Force leaders should be careful not to prematurely retire aircraft they may need in the future.
5. **Networking:** Every bomber must be connected as critical elements of the combat cloud to facilitate rapid and seamless data gathering, processing, and dissemination across platforms and domains. With requisite size, payload, and power generation capacity, bombers have enormous potential for operating as key nodes in the distributed, decentralized future combat cloud architecture.
6. **New Missions:** The extraordinary versatility of the bomber force allows for the expansion of bomber missions beyond long-range air-to-ground strategic attack and interdiction. The payload and range of these platforms offers important advantages for a diverse range of missions such as maritime strike, ISR, close air support, air defense, and electronic warfare, while also affording size, weight, and power for the integration of new technologies like hypersonic munitions and directed energy systems. Upgrade priorities, funding levels, and general force management decisions must appreciate all these strengths, not just the traditional bomber air-to-ground strike function.
7. **Weapons:** Future weapons development, especially with hypersonic and directed energy weapons, will likely generate significant operational advantage if these capabilities are paired with the bomber's ability to carry large numbers of weapons, transit long distances, persist in areas of interest, and penetrate defended regions. Distinct advantages can also be leveraged by further integrating existing weapons into the bomber portfolio.
8. **New Metrics:** The Department of Defense (DOD) must establish a new set of metrics to determine mission system value on a normalized "cost per effect" basis. It is well past time to start measuring mission cost per output delivered relative to total enterprise costs.
9. **Aircraft Readiness:** Readiness accounts must be robustly funded on a continual basis. While funding can and should be directed to airframe enhancements that improve the mission capable rate of a given platform, there is no greater determinant of aircraft readiness than steady and predictable operations and sustainment funding. Operations in Southwest Asia have established that with proper manpower and spare parts, even legacy bombers are sustainable at mission capable rates similar to other Air Force combat aircraft.

The sobering reality is that the United States is confronted by a dangerous future, and the nation's well-being fundamentally depends upon making smart decisions that yield the greatest military value, thereby affording leaders with a broad range of robust options. Fortunately, it is not too late for the US military and the Air Force to rise to this challenge. It is time to grow America's bomber force for the 21st century in an era of burgeoning, increasingly complex challenges.

Introduction

The United States faces an inflection point regarding how it projects power in an environment defined by burgeoning threats and a complex set of security imperatives. Since the end of the Cold War, Americans have rightfully assumed their nation possessed military superiority, no matter the situation. However, those dynamics are radically changing, as today multiple competing nations are concurrently developing strategies and fielding advanced capabilities specially designed to counter US combat power. As the Senate Committee on Armed Services recently declared:

The array of national security threats facing the United States is more complex and diverse than at any time since World War II. The strategic environment has not been this competitive since the Cold War. Simply put, America no longer enjoys the comparative edge it once had over its competitors and adversaries.¹

As adversaries seek to challenge US power projection capabilities, routine patterns of employment stand as a recognized vulnerability. The 2001 *Quadrennial Defense Review* explained: “Future adversaries could have the means to render ineffective much of our current ability to project power overseas. Saturation attacks with ballistic and cruise missiles could deny or delay US military access to overseas bases, airfields, and ports.”²

Seventeen years later, the future has arrived. Rivals and potential adversaries have observed America’s long-established pattern of operations and are developing methods to negate our traditional concepts of operations. Amidst these evolving circumstances, it is necessary to reassess long-held assumptions regarding the capability and capacity of US military force structure. This is particularly the case when it comes to the size of the US Air Force’s bomber fleet—which is now the smallest it has ever been since the founding of the service in 1947.

The present security environment calls for growing America’s long-range aircraft strike force larger than its current inventory of 157 bombers. America ended the Cold War with over 400 bombers, arrayed to fight one superpower, the Soviet Union. Countering multiple modern adversaries will demand a highly capable hybrid force—comprised of new B-21s, as well as modernized legacy bombers like the B-1B, B-2, and B-52. Bombers are the most cost-effective option to deliver both long-range, rapid power projection capacity and capability to combatant commanders around the globe. This study argues for an objective of 270 bombers in the Air Force inventory: 180 B-21s and 90 legacy bomber aircraft types. This approach departs from the Air Force’s current stated position, which retires the B-1B and B-2 before the B-21’s initial production allotment is complete—a decision driven by budget and personnel factors determined before the new National Defense Strategy was released in January 2018. The planned retirements of long-range, high payload capacity aircraft would yield a force of 175 bombers, a force size inadequate to meet the requirements stated in the new National Defense Strategy. This premature divestiture also risks growing the bomber capacity gap in the event of B-21 production delays or a curtailed buy. It is not smart to divest a valuable capability until its replacement is guaranteed.



Above: (From left to right) A three-ship formation of B-1B, B-2, and B-52 bombers, fly near Barksdale AFB, LA on February 2, 2017. Countering modern adversaries will demand a highly capable hybrid bomber force, composed of new B-21s and modernized legacy bombers such as the B-1B, B-2, and B-52.

The new National Security Strategy, National Defense Strategy, the growing near-peer threats of China and Russia, and continued instability in regions like the Middle East mandate that the United States close the gap between real-world demand and available force structure. Failing to pursue this path will see valuable strategic, operational, and tactical options fall off the table. The Department of Defense (DOD) has few options when it comes to long range power projection on a global level. A good “Plan B” does not exist without bombers. The new B-21—if procured in sufficient numbers—paired with a modernized B-52, B-1B, and B-2 force can avert the current shortfall and ensure security requirements are met years into the future.

The high end of the spectrum is more dangerous than ever. As the 2018 National Defense Strategy explains: “Deterring or defeating long-term strategic competitors is a fundamentally different challenge than the regional adversaries that were the focus of previous strategies.”³ Nations around the globe are turning to overtly aggressive action to advance their interests. China is harnessing attributes of hard power to expand its territorial claims in the South China Sea and beyond. Russia is willing to engage in blatant acts of hostility in places like eastern Ukraine and Syria. North Korea is continuing to increase its nuclear weapons capabilities, and Iran is pressing its adversarial actions across the Persian Gulf. All the while, the threat posed by non-state actors continues to evolve in new, challenging ways. The globe is increasingly unstable, as a result. Highly predictable regions are now buffeted by significant change, and US interests and priorities are at risk with both military capability and capacity stretched thin.



Above: An Air Force B-52 leads a formation of US Air Force F-16s, Polish F-16s, German Eurofighter Typhoons, and Swedish Gripens over the Baltic Sea, as part of Exercise BALTOPS, June 9, 2016. The bomber force is a vital tool in the US arsenal to meet the demands of the new National Defense Strategy, which cites the importance of deterring or defeating long-term strategic competitors.

The burgeoning threat environment is also of increasing concern because potential adversaries have the means to actualize their intent, thanks to concerted investment in a new generation of advanced military capabilities. This list includes advanced air defense systems; long range precision strike; deployed, decentralized airborne command and control; robust intelligence, surveillance, and reconnaissance (ISR) functions; and enhanced computing capacity. Enemy commanders will likely be able to target American and allied forces in future conflicts with an incredibly lethal combination of range, precision, and mass. The US has not faced these types of threats since the Cold War. Strategies, operational practices, and military hardware built for the 20th century can no longer be assumed to be “good enough.” Factors like wartime attrition and reserve forces must be considered again. Mass, concurrency, and survivable power projection becomes increasingly important given the scale and scope of these new challenges.

With adversaries aggressively pushing forward, the Air Force must act fast to realign its capabilities and capacity with a requirements-driven force, not one shaped unduly by arbitrary budget targets. This challenge is not just about buying more of what the service already has, but generating the right balance of capabilities. Looking to the future, these include:

1. **Range**, which is important for two key reasons. First, it allows the bomber force to strike nearly any target no matter its distance. Many key facilities lie deep within adversary territory with bombers one of the few assets capable of reaching these targets early in the conflict. Second, range enhances survivability by permitting the bomber force to operate from bases beyond the reach of our adversaries’ anti-access capabilities and lessens US and allied reliance on tankers.

2. **Responsiveness** means that the bomber force can react quickly to emerging crises around the globe. Unlike other elements of the US military and the forces of US allies, the response time of bombers is measured in hours—not days, weeks, or even months, as other forces require. Furthermore, bombers can move easily from one theater to another, potentially from the same base. This strategic flexibility makes them exceptionally useful in an uncertain, multi-polar world.
3. **Payload** gives the bomber force the ability to bring a large number of weapons and highly specialized capabilities into the fight. This includes swarms of cheap munitions to swamp adversary air defenses, specialized penetrators to defeat deeply buried targets, powerful sensors to better understand the area of operations, and potentially non-kinetic payloads that support integrated, systems destruction warfare.
4. **Survivability** permits bombers to prudently and decisively attain effects regardless of threat. Aircraft that feature stealth technology, like the B-2 and the B-21, can strike targets anytime, anywhere. Older non-stealth bombers such as the B-1B and B-52 also complicate an enemy’s defensive calculus at the high end of the threat spectrum by using standoff missile capabilities and ISR to locate targets. The combination of these survivability aspects imposes steep costs upon an enemy and radically complicates their defense strategy.
5. **Versatility** is also a vital capability the bomber force provides. Regardless of type, all bombers now execute missions that extend far past their historic roles as long-range air-to-ground strategic attack and interdiction strike aircraft. Additional mission areas include counter sea attack, ISR, persistent direct attack, close air support, and electronic warfare. Future growth areas include deployed, airborne decentralized command and control capability as integral elements of the combat cloud, and integration of new technologies like hypersonic munitions and directed energy weapons, as well as cyber-attack tools.

From an airpower perspective, this collection of desired attributes points to a common capability: long-range sensor-shooters—historically known as bombers. Operating across long distances, carrying large loads, fielding highly capable sensors and processing power, and transiting anywhere on the globe in a matter of hours—the defining virtues of the bomber force speak directly to the attributes required by today’s and tomorrow’s threat environment. These aircraft will radically complicate an enemy’s defensive calculus and yield valuable options for US commanders.

Bombers’ strengths are not reflected elsewhere in the current US military inventory. Naval vessels are slow and increasingly vulnerable to modern weapons. Land forces require significant deployment time, are also vulnerable to attack once employed, and lack extended power projection capabilities. The majority of America’s airpower portfolio consists of short-range aircraft, with limited payload carriage. Taking all these considerations into account, the argument for long range sensor-shooter aircraft is simple—maximize the capability to rapidly project power. This may also be termed “mission-based affordability,” which sees desired combat effects realized in a highly efficient fashion when viewed from a cost-per-effect vantage.



Above: Maintainers with the 131st Bomb Wing service a B-2 bomber at Whiteman AFB, MO during early morning operations. Operating across long distances, carrying large payloads, fielding highly capable sensors, wielding enormous processing power, and having the ability to transit anywhere on the globe, the bomber force's virtues address the challenges of today's and tomorrow's threat environment.

Beyond the capabilities of individual aircraft in the modern bomber force, it is important to understand that force size matters too. In the years after the Cold War, US forces faced threats that resulted in relatively few losses compared to earlier conflicts. Future wars facing increased enemy defenses demand that higher attrition calculations be built into the force structure. Additionally, unlike the limited regional missions that defined conflicts of the post-Cold War era, future wars will likely encompass larger operating areas—thereby increasing demand for a greater number of bomber aircraft.

BOMBERS			
1990		2018	
B-1B	96	B-1B	62
B-2A	1	B-2A	20
B-52G/H	230	B-52H	75
F-111A/D/E/F	286		
F-117A	48		
Total	661	Total	157

Figure 1. The Air Force's strike capacity has declined precipitously over the past 28 years, with the demand for these capabilities only growing.

However, amidst these trends calling for more aircraft, America's present bomber force is too small to meet the tenets of the current National Defense Strategy. The US sought a "peace dividend" following

the Cold War, and as a result, the Air Force reduced long-range strike capacity by radically cutting the B-2 acquisition by 85 percent and halving both the B-1B and B-52 force. In total, the bomber inventory was slashed from 661 airframes when the Berlin Wall fell to 157 aircraft in 2018—a 76 percent reduction in bomber aircraft.⁴ While resources were focused on making the remaining bombers more effective through introduction of precision strike capabilities and a range of other upgrades, a small force, no matter how capable, can only be stretched so thin on the global stage in an era where threats are on the rise.

A considerable portion of this force downsizing coincided with a focus on combat operations in Iraq and Afghanistan that resulted in investments on the low end of the threat spectrum. Furthermore, the Budget Control Act of 2011 cut several vital force modernization efforts and multiple continuing resolutions have further eroded finite investment dollars. These actions yielded a highly compromised set of airpower capabilities. As Secretary of the Air Force Heather Wilson remarked: “We have an Air Force that is the oldest Air Force and the smallest Air Force in its history.”⁵ Nor is she alone in this assessment. The late Senate Armed Services Committee Chairman John McCain declared in June 2017 that the situation was “a full-blown crisis, and if left unresolved, it will call into question the Air Force’s ability to accomplish its mission.”⁶

While the acquisition of the B-21 certainly stands as a crucially important decision in reshaping America’s defense portfolio, the Air Force’s new “bomber vector” suggests that the service is planning on maintaining an inventory of only 175 bombers—B-21s and B-52s, with B-1Bs and B-2s slated to retire in the 2030s. This force size is too small to meet the current defense strategy and is simply inadequate for today’s security environment. Decisions need to focus on mission requirements, not just up-front cost. It also risks retiring aircraft before their replacements have been fielded in a fully mission capable fashion.

To build the force structure needed for the 21st century, the Air Force should consider retaining and modernizing its legacy force of B-1Bs and B-2s until it can procure B-21s in larger numbers. This additive approach, in combination with the stated intent to retain and modernize the B-52, grows the bomber inventory, and closes the gap between demand and available assets in an era when range, responsiveness, payload, survivability, and versatility matter more than ever. This speaks directly to the demonstrated requirement of meeting both high-end mission demands in increasingly complex threat environments, while also allowing efficient power projection against long standing operations against non-state actors and other persistent adversaries. While this plan will require additional funding beyond current budget allocations, the service needs to advocate for greater resources based on the National Defense Strategy—particularly considering that bombers are far more cost-effective and combat capable than other forms of power projection.

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Potential adversaries are aware of the capacity challenges facing the US military. This emboldens them to press forward with aggressive actions because they believe that the US will self-deter from engaging in conflict. An inadequate set of tools will result in lives lost, mission objectives ceded, and risk defeat in war. A larger long-range sensor-shooter force will deter enemy action and stabilize the globe against aggression. Preventing war is always cheaper than fighting one.

Former Secretary of Defense Donald Rumsfeld famously once explained that “you go to war with the Army [Navy, Air Force, and Marines Corps] you have, not the Army [Navy, Air Force, and Marines Corps] you might want or wish to have at a later time.”⁷ While Rumsfeld did not win any popularity points with that blunt assessment, he was exactly correct. Modern conflict emerges quickly, is unpredictable, and requires decisive force. Drawn out wars of attrition caused by military parity or a lack of strategy, are not in America’s interest. Over the past 17 years, the US military has overwhelmingly focused on counter insurgencies and limited contingencies. Today, geopolitical dynamics are shifting back to an era of great power competition—a struggle where America’s most crucial interests are on the line. That is precisely why the Air Force needs to take the initiative now and grow its long-range sensor-shooter capabilities and capacity.

The Essence of Bombers

The origins of long-range strike missions date back to World War I and are inherently tied to the air domain. Airmen flying over the bloody trenches looked down and determined there must be a better way to attain victory than strategies based on linear surface power projection, forced occupation, and attrition warfare. As airpower leader and pioneer Army Brig Gen William Mitchell explained in the aftermath of the conflict:

Armies proved conclusively in the last war that they could not gain victory. For four years they faced each other across a lot of ditches in northern France and went backward and forward only a few miles. Millions of men were killed and wounded; billions of dollars were spent; natural resources became exhausted; lines of communication were destroyed or greatly impaired. All that happened only went to prove that the armies, following an entirely worn-out theory that they could advance and capture the vital centers of the enemy against an opposing army, had not taken a proper count of modern means of defense, such as the machine gun, the rapid-fire cannon and toxic gasses. By their ignorance of modern methods and devices, they brought the world to the verge of ruin.⁸

Seeking a more effective and efficient path to victory, airmen proposed flying past the fielded enemy ground forces to strike the centers of gravity that sustained their power projection capacity. As Mitchell further explained: “The advent of airpower which can go straight to the vital centers and entirely neutralize or destroy them has put a completely new complexion on the old system of making war.”⁹

Prior to the advent of combat airpower, strategists assumed that military force had to be projected in a linear fashion. Few alternatives existed, whether on land or at sea. The only way to get to an enemy’s central war-making enterprises was to fight through opposing surface forces. Airpower changed the entire equation, forever redefining warfare by going over, not through enemy units on land or at sea. Projecting airpower against the heart of an enemy’s war enterprise at the onset of a conflict was a fundamentally new concept.

While technology has advanced radically since the dawn of airpower, the intent of the long-range strike mission has remained remarkably constant. Whether deterring a foe by holding targets of value at risk, or launching decisive missions, the essence of the mission centers upon highly effective, efficient power projection. This might involve hitting command and control centers, production sites, logistics lines, power generation facilities, petroleum stores, or other elements of infrastructure. If the adversary is a non-traditional actor like the al-Qaeda terrorist group, or the Islamic State, strikes might be directed against economic means of support, communication methods, and leadership targets. In this approach, the goal is to eliminate an enemy’s war-making apparatus by striking targets that will net the greatest impact. This strategy, if properly designed and executed, will cripple an adversary’s ability to sustain combat operations by eliminating the resources needed to project military power—like depriving an engine of fuel.

Taken in this context, bombers possess five key attributes that distinguish them from other assets in the DOD inventory, enable them to deter aggression, and deliver decisive effects: **range, responsiveness, payload, survivability, and versatility.**

Source: Jane's All the World's Aircraft. Artwork: FoxbatGraphics

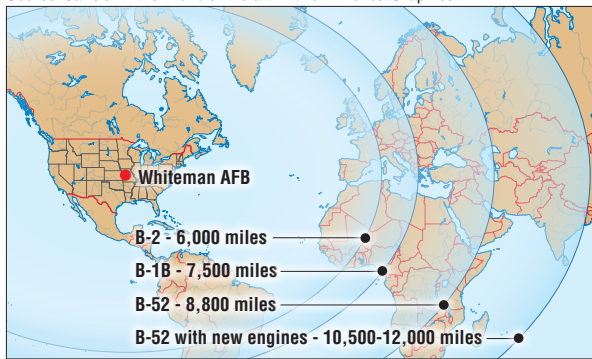
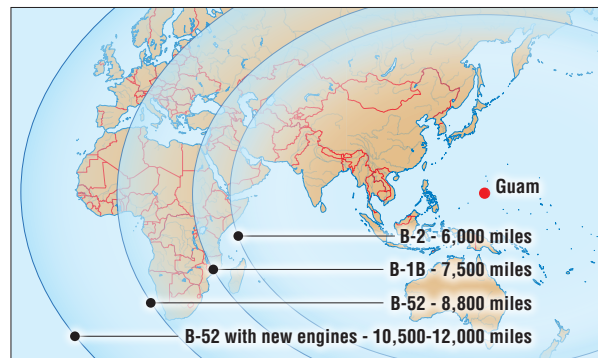


Figure 2. Bombers possess incredible range with their internal fuel stores and aerial refueling further extends this reach.



Range

Bombers can reach targets on a global basis and do so in a large scale and decisive fashion. Former Secretary of the Air Force Donald Rice explained this vital advantage in the 1992 version of the seminal Air Force white paper *Global Reach, Global Power*. “Our global power ensures our friends are not alone. With our responsiveness, potential adversaries understand that distance does not mean disinterest,” the paper states.¹⁰ The ability to strike any target, any time is a powerful combat advantage recognized by America’s allies and feared by adversaries. This is especially important given the burgeoning threats that will define the future operating environment. No longer will regional operating bases and support aircraft like aerial refueling tankers be able to function in relative sanctuary. Enemies can increasingly hold these crucial assets at risk thanks to longer range weapons and improved situational awareness. This will place a premium upon a bomber’s long reach, which affords commanders the ability to project combat power without excessively relying upon assets within the reach of enemy attack. Success in the modern era demands projecting strength, while minimizing the exposure of undue vulnerability.

Reaching the Targets

When it comes to wartime priorities, few rank higher than reaching a target. This can often be a challenge when geographic depth affords sanctuary for prospective adversaries. For example, it is no mistake that Russia and China both choose to base important counter-space capabilities in the middle of their respective countries. These are critical installations that the United States would target in any conflict, and their interior location fundamentally limits available strike options. As these threats become increasingly mobile, addressing these targets becomes all the more challenging, requiring the combination of high-fidelity situational awareness, rapid response, range, and survivability. Would-be enemies understand these variables and seek to harness them to their benefit. As the 2001 *Quadrennial Defense Review* noted:

Adversaries will also likely seek to exploit strategic depth to their advantage. Mobile ballistic missile systems can be launched from extended range, exacerbating the anti-access and area-denial challenges. Space denial capabilities, such as ground-based lasers, can be located deep within an adversary’s territory. Accordingly, a key objective of transformation is to develop the means to deny sanctuary to potential adversaries. This will likely require the development and acquisition of robust capabilities to conduct persistent surveillance, precision strike, and maneuver at varying depths within denied areas.¹¹

The importance of a bomber for this mission is magnified when basing restrictions require aircraft to travel a long distance before reaching enemy airspace, or when anti-access challenges necessitate long standoff ranges for aerial tankers. In recent conflicts, tanker orbits have often flown very close to enemy territory. These aircraft may not have this luxury in future wars due to increased enemy air defense lethality. Bomber aircraft help mitigate these dynamics by using their range and survivability to reach “deep targets” in enemy territory, without requiring tankers to fly into harm’s way.

The bomber’s range also forces an enemy to defend all their territory in the event of conflict, rather than just the periphery. This translates into a huge cost imposition. Resources spent on defense cannot be used for offense.

Attacking deep targets may be the most vital mission for the bomber force during the early days of a conflict. These missions will often involve striking an enemy’s offensive weapons that threaten space-based systems, destroying long-range strike weapons, and potentially targeting weapons of mass destruction. It should be noted that smaller countries can achieve a type of strategic depth by making key capabilities mobile and then placing them in their heartlands. A “Scud hunt” for mobile missiles in the middle of a smaller nation, for example, may be just as stressing as a strike on a fixed target in a more geographically remote region of a larger nation. While the exact nature of the geographic challenge posed by potential adversaries is not clear, it is apparent that any future strike force requires considerable range and endurance to ensure that all targets can be struck from day one.

Protecting Our Assets

Range also enables the United States to protect its valuable assets and operate with greater freedom by staging from bases beyond the reach of most enemy weapon systems. The further away one can operate, the greater safety conferred by simple geography. Nor is it just about installations on the ground. Greater range means less exposure for valuable tankers.

Threats to Bases

Potential enemies have observed and understand established US power projection preferences dating back to the Korean War. The paradigm is simple and has been repeated with great frequency: surround an enemy with regional forces and then execute a high rate of strikes for a sustained period until the adversary is compelled to terminate its aggressive actions. This model generally assumes that bases and ships will not be attacked (and that US and allied forces will maintain sanctuary in rear areas); air superiority will rapidly be achieved; logistics lines will flow uninterrupted, and command and control processes will function near-continually. This model was employed in the Korean War, Vietnam War, Operation Desert Storm, Operation Allied Force, Operation Iraqi Freedom, strikes in Libya as part of Operation Odyssey Dawn and Operation Unified Protector, and ongoing operations against the Islamic State in the Middle East as part of Operation Inherent Resolve.

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However, adversaries have evolved their strategies and tactics to undermine America's ability to freely exploit this paradigm. China has developed a broad variety of systems that can strike US regional bases and naval assets. This is not about an aspirational capability or a silver bullet system. Current capabilities fielded by potential adversaries afford a broad number of strike platforms that can severely degrade US regional facilities in a rapid, concurrent fashion. As the *2017 Annual Report to Congress Regarding Military and Security Developments Involving the People's Republic of China* (better known as the DOD "China Report"), explains:

China's military modernization plan includes the development of capabilities to attack, at long-ranges, adversary forces that might deploy or operate within the Western Pacific Ocean. The PLA has modernized its conventionally armed missile force extraordinarily rapidly. Today, China fields an array of conventionally armed SRBMs as well as ground and air-launched SRBMs as well as ground and air-launched LACMs. US bases in Japan are in range of a growing number of Chinese MRBMs and LACMs. Guam could also be within range of air-launched LACMs, as demonstrated by the H-6K bomber flights into the Western Pacific Ocean last year. The DF-26, which debuted publicly this year, is capable of conducting intermediate precision strikes against ground targets that could include US bases on Guam.¹²

China is not alone in developing these functions. Russia too has several advanced strike options—to include long-range strike aircraft, as well as advanced air, ground, and sea launched missiles. Furthermore, these countries are active exporters of advanced military systems around the globe. China is also increasingly willing to sell low-cost versions of Russian and Western weapon systems to a range of actors. The net effect of these trends is an increasingly dangerous world where a broad range of offensive systems, once the sole domain of superpowers, are now proliferating to a spectrum of lesser actors. This trend is one of the reasons why missions against Iran or North Korea would be so difficult.

Projecting power while under attack is a very difficult proposition that radically reshapes warfighting priorities. US forces have not had to consider fighting in this manner since the Cold War, and have not actually done so on a large scale since World War II. An installation under fire is no longer fundamentally focused on offensive actions. Instead, resources and personnel become dedicated to defense, managing damage, and preparing to address further strikes—these efforts take effort and energy away from offensive power projection. The focus turns to survival, which leaves offensive power projection far down the list of priorities. At a regional base, US forces under attack would struggle to launch the number of strikes required to secure decisive effects.

It is useful to consider the RAND Corporation analysis from the 1980s, which indicated that Soviet strikes against Air Force bases in Europe during the first weeks of hostilities would cut sortie generation rates by almost 40 percent and destroy just under half of the aircraft in the region.¹³ That was in an era before ubiquitous ISR and the proliferation of precision strike weaponry. It is safe to assume modern threats would pose an even more serious set of challenges from both a kinetic and non-kinetic perspective. Given that today's military planning assumes little aircraft attrition and few personnel losses, this is a major problem. It is particularly pronounced for the bomber force, which is at a historic low—never so small since the formation of the US Air Force in 1947.

A strategy that heavily relies on close-in basing is also incredibly resource intensive because it requires considerable investments in defenses and hardening. Ever since the end of the Cold War, the US military has generally managed its basing infrastructure with cost reduction as a primary goal. The matter is further exacerbated by the trend for US aircraft to operate out of consolidated regional hubs. Fewer operating locations allow enemy forces to concentrate available munitions on a small number of targets. While this may have made sense in an era where budget pressures drove a choice between concrete and aircraft, these decisions yielded circumstances where redundancy and protection were eliminated in the short term in trade for reduced expense outlays. Over a quarter of a century later, American forces have a long way to go to make up for this underinvestment.

The question in dealing with this challenge is whether the US can flex its strategy, operational procedures, and tactics, or whether its force structure is so tailored to this regional model that it would be difficult for leaders to seek alternate means of power projection. The world has changed significantly, and America's approach to warfighting needs to adjust. As the 2018 National Defense Strategy explains:

For decades the United States has enjoyed uncontested or dominant superiority in every operating domain. We could generally deploy our forces when we wanted, assemble them where we wanted, and operate how we wanted. Today, every domain is contested—air, land, sea, space, and cyberspace.¹⁴

One effective response to the increased threat against close-in bases involves operating at ranges that extend past the reach of an enemy's offensive systems. Said another way, reach equates to projecting power while mitigating vulnerabilities.

The DOD has faced this challenge before. In the early 1950s, US war plans were highly reliant on regional European bases fielding medium-range bombers to hold the Soviet Union at risk. Realizing the vulnerability of these locations, leaders developed long-range bombers like the B-52 and KC-135 aerial refueling aircraft to improve power projection survivability. Operations were conducted from the continental United States

Below: A B-52 from Minot AFB, ND receives fuel from a KC-135 over the Pacific Ocean during Exercise Tropic Fury. The development of long-range bombers aided by the refueling capacity of the KC-135 in the Cold War was a deliberate attempt by US leaders to improve power projection survivability, and lower sole reliance on regional bases.



MSgt Kevin J. Gruenwald/USAF

(CONUS), thereby mitigating much of the Soviet threat. The bill associated with this transformation was significant, but it served as a lynchpin of America’s strategy for the duration of the Cold War era. With the end of the Cold War, this approach atrophied, but it may be time to revisit it. To this point, in 1963 the Air Force fielded 709 B-52s and over one thousand additional bombers like the B-47 and B-58. Today, it has only 157, of which only a portion are combat capable at a given point in time—numbers matter.¹⁵

Given this major challenge, it is time for the US military to rescope its capabilities to reflect the current threat environment. This means once again adopting a strategy based upon projecting massed effects application from range. Thanks to the long reach of bombers, they can operate from a wide variety of facilities far outside the range of offensive enemy systems—even from the continental United States. No longer would an Asia-Pacific scenario be solely dependent on a handful of facilities like Kadena Air Base on Okinawa and Andersen Air Force Base on Guam. An entirely new range of host facilities enter the planning picture, with

...it is time for the US military to rescope its capabilities to reflect the current threat environment. This means once again adopting a strategy based upon projecting massed effects application from range.

regions like Australia and Southeast Asia offering new potential.

Protecting the Tankers

Aerial refueling can extend the range of nearly any combat aircraft. However, small aircraft require significant amounts of tanking when long-range operations and extensive loiter times are called for. For some missions at extreme distances, the tanker-to-fighter ratio can exceed one-to-one. Beyond about 1,400 nautical miles, the number of tankers required to support each fighter sortie becomes excessive.

This is an important factor to consider given that “booms in the air” can often constrain how much combat airpower can be in the sky at any given time. If aircraft cannot get the fuel they require to complete their respective missions and get back home safely, they are not launched.¹⁶

The requirements for tanking also dramatically complicate regional basing architectures. There are only a small number of bases that can support large numbers of tankers and the prodigious fuel quantities needed to support high-tempo combat operations. This is a hidden constraint that often goes underappreciated. In places such as the Western Pacific, the existing basing infrastructure is likely insufficient to support large numbers of fighters flying sorties that often exceed 1,000 miles.

Lastly, tanker limitations also enter the equation another way. As air defense systems grow more lethal and increase their range, survivability concerns will see aerial refueling aircraft pushed further away from targets. The ripple effect of this change will likely prevent shorter ranged airplanes from striking vital targets, save for those at the extreme periphery of an adversary’s territory, for they will simply lack the reach.

If shorter range aircraft are the only airplanes available to undertake a given mission, then additional fighters will have to be assigned to protect tankers as they fly closer to adversary threats. One can quickly see how the need to refuel strike aircraft, combined with the need to maintain a defensive fighter cover in front of the tanker force, drives a significantly elevated resource requirement—whether viewed from aircraft assigned to a given mission, logistics support, or airborne refueling.

Bombers can avoid this sub-optimal use of resources by harnessing their reach to push back the point of last refueling and “go deep” striking critical targets within an adversary state.¹⁷ This keeps tankers safe and reduces demand for air superiority assets in this given scenario. This approach efficiently uses resources given the mission parameters, threat, and available aircraft. A robust bomber force ultimately presents national leadership and combatant commanders with a wide array of force employment options.

To put the comparative scale of bomber range in context, and the impact this has upon mission planning options, a single refueling extends the reach of a B-2 from 6,000 miles to over 10,000 miles.¹⁸ This is comparable to flying from Seattle, Washington to London, England and back—with only one aerial refueling. The B-52 today can fly 8,800 miles on a single mission, unrefueled (an Air Force re-engine program, now underway, could extend the bomber’s unrefueled range as much as 40 percent).¹⁹ Similarly, the B-1B is able to operate over 7,500 miles without refueling. These aircraft were designed to operate from the continental US, strike targets in the Soviet Union, and return home. Once again, this type of range is proving increasingly important.

Responsiveness

While related to range, responsiveness is the ability of the bomber force to quickly react to emerging threats wherever they occur. Short of intercontinental ballistic missiles and sea-launched ballistic missiles, bombers are the only assets in the US military that offers reaction times measured in hours rather than days, weeks, or months with little to no notice. This capability can be further enhanced should bombers be pre-positioned in theater as tensions begin to climb. For example, continual bomber rotations to Guam send a powerful deterrent message to nations in the region despite being over 2,000 miles from Pyongyang and 1,700 miles from the Taiwan Strait. Bombers, simply through their presence, can yield flexible deterrent effects.



TSgt Richard P. Ebersberger/USAF

Above: B-1B bombers assigned to the 9th Expeditionary Bomb Squadron arrive at Andersen AFB, Guam from Dyess AFB, TX, February 6, 2017 to take over US Pacific Command's Continuous Bomber Presence mission. These rotations to Guam send a powerful deterrent message to potential adversaries in the region, such as North Korea, as their mere presence can yield flexible deterrent effects.

The increasingly multi-polar nature of the evolving global security environment means the United States needs forces that can rapidly reposition from one region to another. Agility and operational unpredictability stand as hallmarks of Secretary of Defense James Mattis' approach to global force employment. While forward based forces are a key component of the US defense strategy, they lack the ability to be strategically flexible. Whether looking at the attack at Pearl Harbor in 1941, the end of the Cold War in 1989, Iraq's invasion of Kuwait in 1990, or the September 11, 2001 terrorist attacks, the US has a poor record of anticipating strategic surprise. An armored division does not move fast, nor does an aircraft carrier battlegroup.

The challenges associated with rapid combat deployments are effectively illustrated by the US Army's efforts to deploy 24 AH-64 Apache attack helicopters to a base in Albania during the 1999 Kosovo campaign, Operation Allied Force. Setting up the base took 667,000 square meters of rock for 58 landing pads; 26,000 tons of support equipment including 24 support vans, 12 M-1 tanks, 42 Bradley Fighting Vehicles;

If the United States or its allies do not possess sufficient bases in a given region, aircraft with longer range capability must be used. Crew physiological limitations prevent smaller aircraft from undertaking the long-haul missions the bomber force routinely execute.

24 rocket defense systems; 37 utility helicopters, and 6,200 troops. Some 2,200 airlift sorties were also required to get this infrastructure into theater. In the end, the helicopters were never used because the conflict was over by the time they became available for operational employment.²⁰

The responsiveness of the bomber force is best exemplified by two operations. On the first night of the Gulf War air campaign, seven B-52Gs of the 596th Bombardment Squadron launched a new weapon, the AGM-86C Conventional Air Launched Cruise Missile (CALCM), against the heart of the advanced Iraqi air defense system. The mission, colloquially referred to as Operation Secret Squirrel, took 35 hours and saw the B-52s cover over 14,000 miles as they completed the roundtrip to the Middle East

from Barksdale AFB, Louisiana. The CALCMs struck their targets and helped open the door for other US aircraft to "go downtown" and nullify the significant Iraqi air defenses at the outset of the campaign. This mission demonstrated the value of globally responsive forces armed with advanced weapons. In a more recent example, on January 19, 2017 two B-2s flying from Whiteman AFB, Missouri released dozens of precision munitions on an Islamic State training camp in Libya. This 33-hour mission again showcased the responsiveness, range, and flexibility of the bomber force.²¹

Beyond the time and distance element of responsiveness, there is also an important question of theater access to consider. If the United States or its allies do not possess sufficient bases in a given region, aircraft with longer range capability must be used. Crew physiological limitations prevent smaller aircraft from undertaking the long-haul missions the bomber force routinely execute. To put this in perspective, a 12-hour mission is similar to driving from Washington, DC to Chicago, Illinois without stopping. Today's long-range strike missions often extend past 20 hours. There comes a point when human endurance becomes a factor, especially when the mission involves multiple air-to-air refuelings and enemy opposition. While fighter aircraft have executed these sorts of missions (F-15Es flew 15-hour sorties during the first

phase of Operation Enduring Freedom in Afghanistan, for example) they quickly exhaust pilots and use assets inefficiently.²² The 15-hour mark represents the extreme limit of fighter aircraft endurance.

This is an especially important issue to consider given that airbase access is a commodity in increasingly short supply around the world. The number of permanent, major operational USAF bases overseas has steadily declined from a peak of 98 in 1956, to 30 in 1990, to 13 today.²³ This diminishing resource translates into fewer options for military leaders. While securing access to another country's operating facility is always a potential option, such action takes time and a willing partner.

Basing was a major constraint facing commanders in the fall of 2001, when the US found itself launching Operation Enduring Freedom against Taliban forces in Afghanistan. With no facilities in the region, bombers and aircraft carrier-based airplanes flew 88 percent of all sorties during the first three months of the campaign. Due to their inherent advantages with regard to payload, bombers dropped the vast majority of munitions.²⁴ In fact, during the first few months of OEF, 24 bombers flew 11 percent of the sorties, but dropped 75 percent of munitions.²⁵

The Afghanistan air campaign was not the first time the US encountered basing constraints. Political variables in host nations are often complex and create additional challenges for the force projection equation. For example, shortly after the American military wound down combat operations in Southeast Asia after the Paris Peace Accords were signed with North Vietnam, local political factors cost the US military access to six air bases in Thailand between 1973 and 1974. In 1992, similar local factors drove US military forces from Clark Air Base and Naval Base Subic Bay in the Philippines. In 2002, US forces also left bases in Saudi Arabia and relocated to Qatar.²⁶ The following year, during the initial phase of Operation Iraqi Freedom, Turkey severely limited power projection options for US forces seeking to invade northern Iraq from Turkish facilities. The experiences of the United States over the past several decades have conclusively shown that global circumstances evolve, often with little notice, and regional access must adjust accordingly. As the 2001 *Quadrennial Defense Review* explained, the defense strategy “rests on the assumption that US forces have the ability to project power worldwide.”²⁷ This caution holds true today more than ever.

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Payload

Another key bomber attribute is payload. Reaching a target area is necessary, but desired effects must still be generated, usually by dropping ordnance. Mass is still a principle of war and it naturally follows that the more munitions an aircraft can carry, the more effective it will be by striking a greater number of targets. It also increases the flexibility of better matching munitions to targets and delivering sufficient mass against a resilient or well-defended objective. These tasks are crucial, for meeting campaign goals requires rapid execution of a disparate array of strikes that target key adversary capabilities. There is no exact formula as to what might comprise a target list given that each campaign will have different components, but it all comes down to the core elements that allow an enemy to sustain the conflict.

No adversary, whether it be a terrorist network or a nation state, can project power without sustaining resources. Arms, key logistics systems, communication nodes, leadership centers, fielded forces, and infrastructure are all examples that may prove crucial depending on the circumstances. Rapidly depriving the enemy of key enablers is the core aspect of warfighting. Failure to strike decisively provides the adversary elasticity, the opportunity to adjust their approach and compensate for the losses inflicted by limited strikes.

To achieve this goal, the Air Force must always ensure that it has the payload capacity necessary to provide leadership a robust set of options and achieve clear cut effects. This was exactly what occurred during 1991's Operation Desert Storm. As then-Secretary of the Air Force Rice explained in a 1992 Air Force white paper: "Allied aircrews shut down Iraq's oil production, electricity, transportation, communications, and ability to produce weapons of mass destruction with a mere one percent of the bombs dropped in 11 years in Vietnam."²⁸ The Desert Storm air campaign demonstrated the crippling impact of airpower enabled by precision weapons, integrated battle networks, and a new generation of battlespace awareness systems.

Munitions

Continued advances in weapons technology will expand the combat effects of bombers. This translates to an expanded set of options for top policy leaders and military commanders. Integration of precision munitions on bombers, like the Joint Direct Attack Munition (JDAM), in the 1990s and early 2000s increased the value these aircraft provided on an exponential level. It is now time to prioritize further bomber force munitions carriage expansion. Combat operations over the past seventeen years focused on the lower end of the threat spectrum requiring highly discriminate kinetic capabilities. With the current threat environment expanding, new mission requirements will demand a broader range of effects. As an example, mass carriage of GBU-39 Small Diameter Bombs (SDBs) could see an aircraft like the B-1B carry up to 96 weapons and 80 onboard a B-52. Projections generated by Air Combat Command for the B-2 indicate this number could even reach 192 SDBs on a single aircraft. This weapon will prove particularly useful in targeting enemy air defense systems with massed precision. At the same time, its ability to glide more than 40 miles reduces aircraft vulnerability. Given that development and production cost has already been invested in such weapons, future munitions integration is a common sense, prudent decision, as it makes the most of existing capabilities. The same will hold true for new developments like hypersonic munitions when they reach operational capability.

However, the success of Desert Storm was predicated upon having the payload required to launch a large-scale attack in a compressed timeframe. The air component of the Gulf War required a significant number of aircraft. Should the combat air force lack airframes or overall payload capacity, then strategic options begin to erode. As a DOD-sponsored strike study in the early 2000s declared: "The fewer the forces available early [in a campaign], the lower the probability of destroying all required targets in a given period of time."²⁹ Within the US combat aircraft portfolio, and considering the value of payload, bombers are vital tools because of their large carriage capacity. As former National Security Advisor Brent Scowcroft explained, in the Gulf War "the B-52 force only represented four percent of the force, but delivered thirty two percent of the bomb tonnage—more than twice as much as the entire [US Navy aircraft] carrier force combined."³⁰

Since Operation Desert Storm, the combat potential of the bomber force has grown significantly. Thanks to investments in equipping these airplanes with precision weapons, one bomber can strike dozens of independent targets on a single mission. Today, one B-1B can carry 24 AGM-154 Joint Standoff Weapons (JSOW), AGM-158 Joint Air to Surface Standoff Munitions (JASSM), or GPS-guided Joint Direct Attack

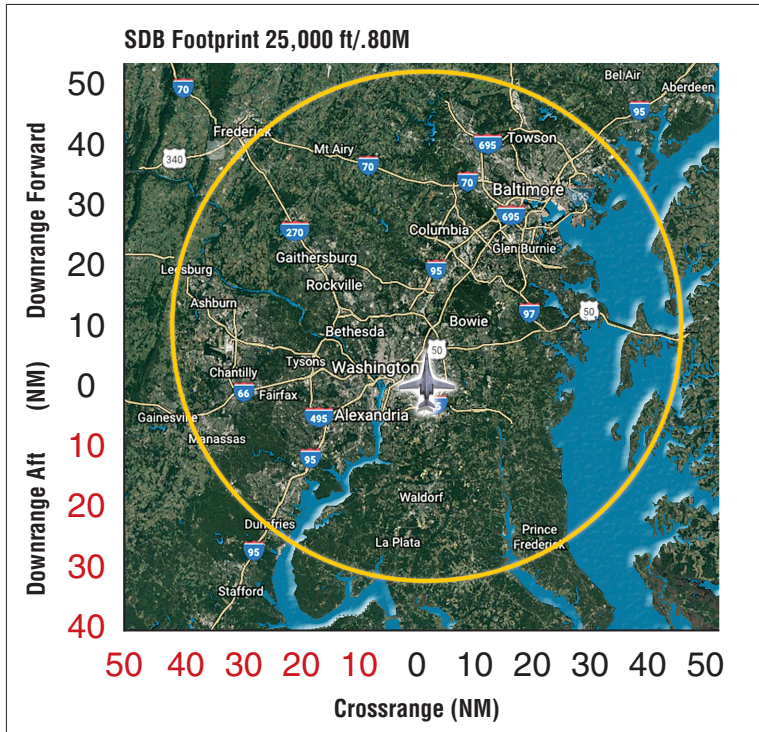


Figure 3. GBU-39 Small Diameter Bombs (SDBs) carried in mass volume on bombers possess an impressive range, an important capability to possess when striking enemy defenses.

Munitions (JDAM); a B-2 can carry 80 independently targeted GBU-38 500lb JDAMs; and a B-52 can carry 20 JDAMs with a newly modified bomb bay.³¹ Future modifications could significantly increase weapons carriage capacity on all three legacy bombers with GBU-39 Small Diameter Bombs (SDBs).

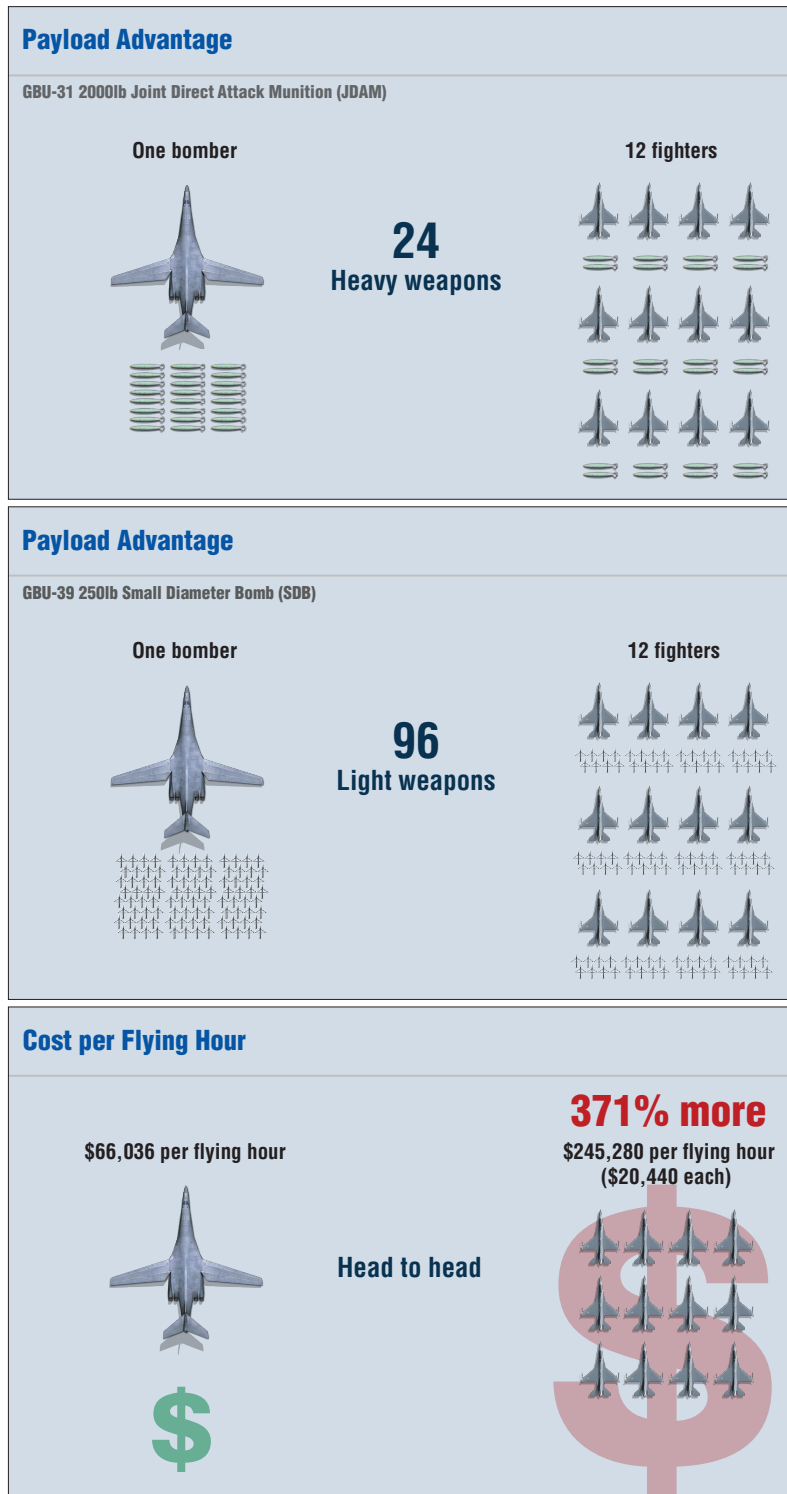
The strategic impact of precision strike cannot be understated. In the early days of combat aviation,

poor bombing accuracy drove airmen to mass large numbers of aircraft against a single target to ensure its destruction. In World War II, missions often involved over one thousand bombers, with 10,000 airmen, and 10,000 bombs to attack a single target complex. However, in the modern era, it is no longer a question of how many aircraft are needed to strike a given target, but instead, how many targets can be hit per aircraft. Entirely new strategic options are now available, thanks to the combination of a bomber's huge payload and ubiquitous precision weapons.

This ability to deliver simultaneous mass effects is why bombers have been used in every campaign since Operation Desert Storm. During the first eight weeks of Operation Allied Force over Kosovo and Serbia, B-2s flew three percent of sorties, but hit 33 percent of targets. Likewise, B-1Bs flew two percent of the sorties throughout the entire conflict and delivered 20 percent of all bomb tonnage. During the first three months of Operation Enduring Freedom, bombers flew 20 percent of sorties, but dropped 76 percent of munition tonnage.³² During the opening phases of Operation Iraqi Freedom, B-1Bs flew one percent of sorties, but released 43 percent of JDAMs and 22 percent of the guided missiles employed.³³ These operations show the stark value provided by a relatively small number of bomber aircraft.

The heavy payload of bombers enables them to deliver enormous firepower in a very short period of time, spread this firepower across a large number of targets, or dwell over a target area for an extended duration to create precision effects. The trend of needing fewer weapons and platforms per target is likely to be reversed. Consider a mission to neutralize an airfield, a target complex that includes dozens of individual targets such as runways and taxiways (which may require numerous bombs to render unusable), hangars, aircraft shelters, dispersal areas, aircraft on the ground, radars, ordnance and fuel storage, maintenance facilities,

barracks, and defensive sites.³⁴ Desert Storm gives a good idea of the level of effort required to neutralize airfields; the coalition allocated 2,990 strikes to 44 Iraqi airfields, or 68 strikes per airfield. Iraqi airfields included 594 hardened aircraft shelters.³⁵



Sources: US Air Force, Jane's All the World's Aircraft, Federation of American Scientists, FoxbatGraphics.

By comparison, China has roughly 200 military airfields.³⁶ Although the number of bases to be attacked depends on the scenario, neutralizing even a few dozen would clearly be a major undertaking. "Point defenses" designed to defeat precision-guided munitions would further increase the number of munitions required to neutralize these airfields. What would take a few bomber sorties to accomplish may require dozens of sorties from smaller aircraft. This is to say nothing of vastly increased tanker and force protection requirements.

The value bombers have yielded in past conflicts relative to other aircraft, combined with the emerging requirement for massed precision, suggests a need for new metrics to understand the true cost involved with force application. To this point, it is important to move away from using "cost per aircraft" as a key metric in force sizing and procurement decisions and instead consider the "cost per effect" or "cost per target/desired mean point of impact."

Figure 4. Cost per effect is a vital consideration, with bombers affording distinct value from a payload and range perspective, as depicted in this chart.

Said another way, what is the most prudent, affordable way to get a bomb on target? Buying the cheapest aircraft normally does not yield the most affordable long-term business case, especially if it takes dozens of them to accomplish the mission. Speaking from a real-world perspective, it is worth noting that two B-1B sorties over Syria as part of Operation Inherent Resolve (OIR) could deliver more ordnance than 40 carrier-based F/A-18 Super Hornets operating from the Persian Gulf.³⁷ During the initial days of OIR, smaller carrier-based aircraft seeking to maximize range to reach their targets carried two GBU-38s per aircraft due to the need for maximum fuel stores. Bombers are able to provide both range and large payload carriage. That sort of power projection from two aircraft, with unmatched responsiveness and endurance, make them incredibly cost-effective and powerful tools. Compare the cost of a B-1B, often cited as “expensive” to maintain and operate, to the cost involved with deploying and sustaining an aircraft carrier battle group; the personnel costs associated with all those ships and individual carrier aircraft; and the expense of that many aircraft to achieve a given effect. To illustrate using engines alone, the comparison is eight engines to procure and sustain two B-1Bs, versus 80 for achieving the equivalent effect with 40 F/A-18s.

Such factors are vital for leaders to consider as they make future investment decisions. What appears “cheap” is often the most expensive way to execute a mission. A World War II-era B-17 costs far less than a B-2, but given that it took 1,000 B-17s per mission to eliminate some targets, the investment required for the advanced technology looks quite reasonable. As the 1999 Air Force bomber roadmap white paper explained: “Bombers provide increased firepower while reducing the size of force packaged and placing fewer aircrews at risk.”³⁸

When seeking to deliver combat effects in defended airspace, survivability is the key attribute for success. Other elements such as range and payload will not matter if the aircraft cannot reach the launch point for its weapons.

Survivability

When seeking to deliver combat effects in defended airspace, survivability is the key attribute for success. Other elements such as range and payload will not matter if the aircraft cannot reach the launch point for its weapons. The best way for an aircraft to penetrate defended airspace and survive is through stealth. Often misunderstood as an invisibility cloak, stealth is a combination of technology and tactics that not only enable an aircraft to evade detection, but that reduces the probability of success of every element of an adversary’s kill chain—not just detection, but also tracking, acquisition, and engagement. Additionally, the technological aspects of stealth are combined with tactics that further complicate an enemy’s ability to target an aircraft. This is not about making an airplane wholly invisible, but is instead an effort to make it much more difficult to target. There is a big difference between detecting an aircraft with sensors and actually accomplishing the sequence of necessary actions needed to net a successful kill. An indicator of stealth technology’s value is provided by the number of nations around the world pursuing stealth aircraft. In future conflicts, stealth is the barrier to entry for operations in contested airspace where aircraft must mitigate the threat posed by advanced adversary ground-based and aerial defensive systems.

The stealth designs of the B-2 and the upcoming B-21 confer them the unique advantage to successfully penetrate defended airspace. The combination of survivability along with their payload and range capabilities

make them well suited for the emerging era of great power competition. For the B-1B and B-52, which do not possess stealth capabilities, a broad array of valuable operating choices still exist however. First and foremost, they can be used for operations in more permissive environments or when those conditions are created following operations of fifth generation systems. This has been routine over the past several years in regions such as Afghanistan and Iraq, where the B-1B and B-52 have highlighted the favorable operating costs of these aircraft from a “cost-per-effect” standpoint. Carrying a tremendous payload of munitions and sensors, combined with the ability to stay on station for several hours, translates into tremendous mission value. This frees up the B-2, and eventually the B-21, for the higher threat missions and preserves the finite lifespan of stealth bombers.

Given that advanced defensive weaponry is proliferating to a broader array of potential adversaries and demand for bombers will continue to outpace available supply, the B-1B and B-52 will be important active contributors in all future conflicts. In contested airspace, threats from surface to air missiles and fighter aircraft with very long-range air-to-air weapons will see these aircraft launch long range standoff weapons like the JASSM-Extended Range variant (JASSM-ER). They may also play an important role by launching decoys and jammers (such as, the Miniature Air-Launched Decoy, or MALD) that would achieve synergistic effects with stealth aircraft. This set of combined attack options radically complicate an enemy’s defensive calculus.

As circumstances evolve, future missions are likely to require weapons with longer range and stealth designs to ensure the viability of the standoff platform and the efficacy of the munition. Hypersonic technology may also afford increasingly useful strike options for the older bombers. Flying at over five times the speed

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of sound, these weapons are nearly impossible to defeat with present technology. Their rapid rate of travel also compresses the kill chain—reducing the time between weapons release and target destruction to a matter of minutes at relevant ranges. This concept relies on another platform or space-based capability to find the target and relay this information to the distant hypersonic missile launch platform—hence the importance of the distributed combat cloud architecture.³⁹

The limiting factor regarding these high-performance standoff munitions is size, cost, and type of targets that can be struck. They are large, which impacts the number that can be carried on an aircraft. They are also expensive, which may prove to be a factor if a campaign involves many aim points.⁴⁰ It is useful to remember that in Operation Desert Storm over 40,000 aim points were struck.⁴¹ Estimates of the number of aim points needing consideration in potential conflicts in North Korea, Iran, and Russia, are 74,000; 82,000; and 250,000

aim points respectively.⁴² At around a million plus dollars apiece per weapon, a pure stand-off campaign becomes cost prohibitive. At the same time, not all targets are vulnerable to long-range munitions. Buried targets typically require a heavier weapon than that carried by a cruise missile (penetrators range between

5,000 and 30,000 lbs in weight). Mobile targets like a missile transporter, erector, launcher (TEL) must first be located and attacked in a very short period before they move. Finally, nations like China have kept their most valuable capabilities deep within their country—beyond the range of most stand-off weapons.

However, while standoff munitions may face certain limitations, they do afford an advantage to US commanders as they seek to complicate an enemy's defensive calculus by projecting a broad range of problem sets in a short period of time. A large, diverse toolkit is always an advantage.

Whether discussing stealth or standoff, the various capabilities afforded by the B-1B, B-2, and B-52 are complementary. Stealth bombers bring mass combat power anytime, anywhere—with few restrictions based on threats. The B-1B and B-52 add strike effects with lower operating costs than stealth bombers. Combined, they yield a broad range of force employment options and tactics that will radically complicate an enemy's planning. As noted airpower analyst Barry Watts once explained, "Much like a diversified stock portfolio, each platform provides a different pairing of likely 'risks' and expected 'returns.'"⁴³ Given that the future is uncertain, a mix of capabilities are powerful tools to hold in the event of 21st century combat. There is not a single defensive system that would easily defeat these aircraft. This is exactly how US commanders should want the state of play—expanding American and allied force employment options and driving uncertainty for the adversary.



Above: A two-ship formation of B-1Bs with the 28th Bomb Squadron, Dyess AFB, TX release chaff and flares while maneuvering over New Mexico on a training mission. The B-1B and the B-52 add complementary strike effects capabilities to the bomber force with lower operating costs than stealth bombers, and combined with their stealth counterparts can yield a broad range of force employment options.

Versatility

When it comes to attaining combat effects in a decisive, effective, efficient fashion, bombers provide combat commanders tremendous value thanks to their versatility. They are able to prudently net a broad range of effects anytime, anywhere. All bombers, regardless of type, now execute missions that extend far past their historic roles as long-range air-to-ground strategic attack and interdiction strike aircraft. As technology and threats change, bombers have demonstrated the ability to undertake missions beyond these traditional roles; this characteristic will continue in the future. Their range, payload, and ability to loiter makes them attractive for a range of potentially vital missions. Emerging technologies are also creating wholly new missions for bombers that will only further their lethality and utility in future joint force operations. Additional mission areas include maritime strike; ISR; persistent direct attack; close air support; and electronic warfare. Future growth missions include deployed, decentralized airborne command and control as integral elements of the combat cloud; computer network attack, potential in the counter-air mission, and integration of new technologies like hypersonic munitions and directed energy weapons.

One of the most attractive future roles for the bomber force is familiar to those who served during the Cold War. The B-52 was once outfitted with the AGM-84 Harpoon anti-ship missiles and employed in

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a maritime strike role. The forthcoming Long-Range Anti-Ship Missile (LRASM), in essence an anti-ship JASSM, could be carried by bombers in large numbers. The maritime strike mission is increasingly important as China builds out its navy and undertakes aggressive military activity across the Asian littoral. If anti-ship missiles have sufficient range, B-1Bs and B-52s can easily strike from beyond the range of ship-based defenses. Given their stealth capabilities, the B-2 and B-21 could employ shorter ranged weapons. Regardless of individual attributes, one thing is certain—any one of the bombers can cover a far broader swath of territory and respond far faster than a ship sailing at twenty knots.

Further investments could also see bomber aircraft assume innovative new roles, like air defense. Empowered with an Advanced Electronically Scanned Array (AESA) radar, the proper processing capability, and air-to-air missile carriage compatibility, there is the potential that bombers could serve as air-to-air missile platforms against a range of threats. While there is no confusing the capability of a B-1B with that of an F-35 or F-22, the reality is that major nation state conflict creates massive capacity demands. Perimeter defense against large aircraft raids is one area where bombers may help provide the deep weapon magazines needed for

success. Bombers might prove capable of engaging adversary cruise missiles, bombers, and aerial support aircraft like tankers and command and control platforms. Their ability to loiter for extended periods, cover broad swaths of territory, move faster than sea-based defenses, hold a large magazine, and provide significant power generation for developing technologies like directed energy weapons due to size, weight, and cooling could turn these warplanes into unique non-traditional air defense assets.

Full Spectrum Upgrades

When looking at future bomber modernization, it is crucial to appreciate mission areas beyond the standard air-to-ground strike role. Further sensor integration will yield tremendous benefits for enterprise awareness thanks to the combat cloud concept. Whether discussing a B-21 or B-2 penetrating heavily defended regions, or a B-1B or B-52 with long loiter capability, the ability to gather data and share it in a collaborative fashion will prove crucial in empowering future distributed command and control. Directly related to this is the need for continued data link upgrades and modern satellite communication capability to ensure real-time multi-domain collaboration. Radar upgrades with Advanced Electronically-Scanned Array (AESA) systems will create new missions, such as bomber-executed cruise missile defense. The same is also true when it comes to the continued integration of anti-ship munitions, allowing bombers to affect the maritime domain with a speed and level of responsiveness not available to naval ships. Defensive capability upgrades will also allow for continued survivable power projection in an era of burgeoning threats.

One of the most overlooked but important aspects of the bomber force are the munitions they employ to destroy targets. Three classes of weapon are vital for the emerging era of great power competition. The first is a smart weapon with multiple, redundant guidance systems that work collaboratively to mitigate adversary jamming. Such a guidance system improves the commander's confidence that the weapons will perform as designed even in the face of a contested electromagnetic domain. Ideally, this would take the form of a new weapon "front end" in the same way that the JDAM is a bolt-on kit for legacy general-purpose bombs. The second is an enhanced rapid reaction weapon that allows a penetrating bomber to engage adversary air defenses and fleeting targets with a high degree of confidence. These weapons work in concert to ensure that the bomber force can deliver the massed precision necessary to achieve decisive warfighting effects. Third, the SDB will radically enhance the volume of effects a single bomber can attain. With upgrades promising to allow a single bomber to carry upwards of 100 SDBs, the ability to target multiple aim points, saturate enemy defenses, and complicate adversary defense planning is unprecedented. It is also a cost imposition strategy, for if an enemy seeks to shoot down SDBs, the missiles required to do this cost far more than the bomb itself. As new weapons capabilities emerge, such as hypersonics and directed energy, bombers provide the size, weight, and power needed in an aircraft to take on these new mission sets.

Bombers also possess capabilities beyond kinetic effects. Sensors and networks will often be more crucial than weapons in meeting mission objectives. The importance of ISR and rapid information processing was regularly exhibited on a continual basis over the past seventeen years in places like Afghanistan and Iraq, where sensor-laden MQ-1 Predator and MQ-9 Reaper remotely piloted aircraft, and targeting pod-equipped manned combat warplanes gained unprecedented situational awareness in real-time. If circumstances warranted, their sensor-shooter capability allowed them to employ weapons as soon as targets were detected. The bomber's capability as a sensor-shooter is immense given the size, weight, and power capacity to support sensor carriage, ability to penetrate highly defended regions in the case of the B-2 and B-21, long dwell potential, and large weapons payload.

For example, in looking at increased military activity in the Arctic, bombers stand to play a very valuable role primarily as sensors first, and shooters second if required. While many analyses view the region through a naval lens, it is imperative to conceptualize this maritime zone through a multi-domain and effects-based perspective. Primary missions include sensing what is occurring in the area, deterring competitors from

taking hostile action, and projecting kinetic force if circumstances warrant. These tasks are all done faster, cheaper, and more sustainably by long-range sensor-shooter aircraft empowered with capable sensor suites. They certainly provide a better option than ships, which would primarily be focused on basic survival in some of the harshest climactic conditions on the planet. Using northern tier bases still in operation in places like North and South Dakota, B-52s and B-1Bs are well positioned for these long-dwell missions that are assuming increasing importance.

Collectively, these characteristics will prove especially vital when threat environments prevent traditional command and control and ISR platforms from penetrating high-threat areas of the operating environment. Penetrating stealth aircraft like the B-2 and B-21 are capable of overflying significant portions of highly defended enemy territory carrying an array of advanced sensors and datalinks. They will be able to link back to standoff aircraft like the B-1B and B-52 with crucial targeting data that can guide long range missiles. This may prove especially useful if a penetrating aircraft is out of munitions or if a specific effect is required that is resident in a stand-off weapon. This approach comes down to ensuring maximum collaboration to best net desired effects in a rapid, decisive fashion.

Combat Cloud

The exchange of information and data will determine success or failure in 21st century warfare. Incredible advances in communication, networking, waveforms, software, automation, data storage, and analysis are enabling an entirely new set of military capabilities. Given these developments, the United States military is at a critical juncture, at the center of an information revolution—where the speed of information, advance of technology, and designs of organizations are merging to change the way US military forces attain desired effects. It is a vision that can be described as a “combat cloud”—an operating paradigm where information, data management, connectivity, and command and control are core mission priorities vice support functions. While mechanical technology—airplanes, ships, tanks, satellites, and other military hardware—will continue to serve as key factors in operations, the information empowering these systems will stand as the backbone maximizing their collective potential. As the combat cloud is developed, it promises to afford an expansive, highly redundant defense complex with radically enhanced data gathering, processing, and dissemination capabilities. These attributes will offer actors at every level of war dramatically improved situational awareness by transforming masses of disparate data into decision-quality knowledge.

Regardless of the decade in which they were built, modern bombers can act as key nodes in the distributed, networked combat cloud operating construct. Practically speaking, this means an advanced capability to gather, process, share, and receive information amongst a broader network of actors. Sensors, computing power, and communications capabilities are more important than ever. This idea is not new, for it is a defining element of fifth generation aircraft like the F-22 and F-35. All of these airplanes are information assets and may be valued in the future for those capabilities beyond their role in generating kinetic effects.

Putting It Together

These unique strengths of range, responsiveness, payload, survivability, and versatility are exactly why leaders so often turn to bombers to facilitate desired policy options. A 2013 study by the RAND Corporation found that:

...considered individually, aircraft are the strike assets that offer decisionmakers the most flexible and responsive tools for crisis management, and long-range penetrating bombers are the strike assets able to contribute the most to structural stability.⁴⁴

During the Cold War, the United States consistently relied on its bomber force to underwrite its security in an uncertain world. The US needs to recommit to these enduring attributes in order to meet the demands of the new security environment. As shown, the current force lacks some of these vital capabilities and does not have sufficient capacity to deliver decisive combat effects in future contingencies. A larger, modernized force would help address these shortfalls.

Building Today's Air Force

Before exploring how to best build a bomber force with the attributes of range, responsiveness, payload, survivability, and versatile combat power, it is important to understand how the Air Force ended up with its current force of 157 bomber aircraft. The current inventory parameters were set in the wake of the Cold War, when America was standing as the world's sole superpower and the globe featured a less complex security environment. There was significant pressure to reduce the defense budget after the Cold War's end, shrink the military, and reap a "peace dividend." Such a climate put the brakes on wide-scale bomber modernization, with the B-2 purchase slashed from 132 planned aircraft to an ultimate buy of just 21. Nor did the legacy fleet go untouched during this period, with major divestiture scaling back B-1B and B-52 numbers, as well as out-right fleet divestitures for variants like the FB-111.

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It was in this setting that then-Secretary of Defense Les Aspin conducted the first, modern joint force structure review, the Bottom-Up Review (BUR). An underpinning premise of the document is that preventing a war is always better than fighting one. Accordingly, the BUR concluded:

The United States must field forces capable, in concert with allies, of fighting and winning two major regional conflicts that occur nearly simultaneously. This capability is important because we do not want a potential aggressor in one region to be tempted to take advantage if we are already engaged in halting aggression in another. Further sizing US forces to fight and win two major regional conflicts provides a hedge against the possibility that a future adversary might one day confront us with a larger-than-expected threat.⁴⁵

The Bottom-Up Review argued for a force of up to 184 bombers to project bombers in a two-theater format, a concept that continues to stand as a logical force sizing parameter. This figure accounted for both the nuclear deterrence force as well as that tasked with conventional employment.⁴⁶

As the years passed throughout the 1990s and early 2000s, the bomber requirement remained relatively stable, often helped by Congressional language limiting retirements and divestiture.⁴⁷ The overall threat environment was largely benign, there were no peer competitors on the horizon, and US leaders were most concerned with low-intensity operations, such as regional conflicts and stability efforts. The 1997 *Quadrennial Defense Review* (QDR) made the case for 187 bomber aircraft. The Panel to Review Long Range Airpower called for 190 bombers—130 combat coded, 24 training, 14 attrition and reserve, 2 in test, and 20 for backup inventory.⁴⁸

Nuclear Deterrence

When assessing the size of the bomber force, it is always important to recognize their unique role in the nuclear triad. New Strategic Arms Reduction Treaty (New START) guidelines, an agreement between Russia and the United States, outline a requirement for 60 nuclear-capable bombers. This is presently met by 18 B-2s capable of being armed with nuclear gravity bombs and 42 B-52Hs capable of being equipped with nuclear cruise missiles. The durability of this agreement is in question given heightened tensions with Russia. At the same time, ongoing nuclear weapons modernization in both Russia and China is driving a reexamination of US nuclear posture. It is also important to understand that the bomber force must be sized to support multiple major combat operations in addition to foundational deterrence mission requirements. Future force structure plans must allow for future capacity growth should circumstances require a more robust deterrent force.

The major development affecting the bomber force during this period was a concerted effort to modernize it with precision weapons capability.⁴⁹ This focus on radically enhancing weapon accuracy mirrored a broader airpower modernization trend. The operational effectiveness and efficiency afforded by the ability of a single weapon to eliminate an entire target was simply too valuable to forgo. This was especially the case for bombers, where force multiplication yielded by one long-range strike aircraft equipped with precision munitions proved immense. To understand the growing ubiquity of these weapons, it is useful to highlight that in Operation Desert Storm, only seven percent of weapons employed were precision weapons. By Operation Allied Force, this rate was up to 35 percent and by Operation Enduring Freedom, 60 percent of weapons dropped were guided munitions. In Operation Inherent Resolve, the air campaign against the Islamic State still ongoing, over 99 percent of weapons dropped are precision guided. Today, unguided munitions are the exception.⁵⁰ The value of the bomber in delivering these weapons, as a result, is dramatically increasing.

While the transition to an all-precision bomber force was an incredibly important capability-enhancing investment, China's rise suggested additional action was required. The 2006 *Quadrennial Defense Review* called for an increase in long-range strike capabilities by 50 percent and an increase in the "penetrating component of long-range strike by a factor of five by 2025." To achieve this, the DOD stated its intent to develop "a new land-based, penetrating long-range strike capability to be fielded by 2018, while modernizing the current force."⁵¹ This was to be the first new bomber since the end of the Cold War. It was also tacit recognition that curtailing B-2 production was a mistake. Called the Next Generation Bomber (NGB), this aircraft was to be globally responsive, carry a flexible weapons payload, be survivable, persistent, come equipped with advanced sensor capability, be capable of autonomous operations, and be readily adaptable for future requirements.⁵²

Despite the advantages afforded by the NGB, the program hit a roadblock in the spring of 2009, when then-Secretary of Defense Robert Gates announced that the FY2010 budget request would terminate the new bomber. The rationale for this decision was directly tied to ongoing wars in Iraq and Afghanistan. Gates explained his thinking in a 2008 speech: "I have noticed too much of a tendency towards what might be called Next-War-itis—the propensity of much of the defense establishment to be in favor of what might be needed in a future conflict."⁵³ With an excessive focus on counterinsurgency efforts during his tenure, Gates has been roundly criticized for effectively kneecapping long term US modernization efforts that reflect the needs of today's and tomorrow's security environment. Investment decisions must focus on long-term interests, not just current security conditions.

The logic supporting a new aircraft with range, responsiveness, payload, survivability, and versatility proved too strong to subvert for very long. Despite Secretary Gates' termination of the Next Generation Bomber, the requirement for a large, stealthy, high-payload, survivable, versatile, and long-range sensor-shooter capability endured. The Long-Range Strike Bomber (LRS-B) program was launched in 2011 and would eventually evolve into today's B-21 Raider. With an initial forecasted force size of 80-100 aircraft, subsequent Air Force leadership statements now call for a minimum buy of 100 airframes. While the program remains heavily classified at a technical level, the overarching attributes are obvious—the ability to project power in quantity anytime, anywhere as both a sensor and shooter.

The decision to launch the B-21 program has proved sensible given the burgeoning global threat environment. As the 2018 National Defense Strategy highlights, the US concurrently faces peer competition from Russia and China; highly capable regional threats in the form of North Korea and Iran; and continued low-intensity operations in places like the Middle East and Africa. Given the breadth of these threats and the substantial challenges they pose when it comes to projecting necessary force from both a capacity and capability perspective, it is evident that the current force of 157 bombers, of which only 20 are penetrating bombers, fall short of meeting current requirements—much less those of the future.

The defense planning system under Gates did not adequately understand the impact of a rising China and a resurgent Russia. At the same time, a dysfunctional budget process exemplified by the fallout from the 2011 Budget Control Act and a series of continuing resolutions crippled the military's ability to adequately plan and prepare for the future. The time is well past for the Air Force to commit itself to the task of building a combat bomber force with the range, responsiveness, payload, survivability, and versatile combat power demanded by the challenges emerging today, and ones anticipated in the future.

Crafting the Force of Tomorrow

With the new B-21 Raider currently in development and legacy bombers in the inventory still possessing highly relevant attributes, the Air Force is presented with a unique opportunity to resize its bomber force to reflect real-world strategy driven requirements. An inventory closer to 300 bombers is a far more accurate end strength goal given real-world security demands. Careful preparation is a crucial investment given that the complexity of modern combat aircraft prevents surge production and associated crew training. Said more directly, the United States will go to war with the forces it has on hand at the time the conflict starts. This drives the imperative of making careful decisions now.

Planning the Force

When executing any kind of force planning, it is useful to lay out key assumptions to guide decision making. This study has already discussed the attributes that the bomber force must possess, but it is also important to highlight what bombers must be able to do, especially in terms of capacity. The key planning assumptions are as follows:

- First, the need for long-range, responsive, large payload, survivable, and versatile combat power is only growing.
- Second, the future bomber force must be capable of addressing concurrent large-scale conflicts to deter aggression on the part of a second actor, and fight and win against them, even if the US is already engaged in combat.
- Third, the future bomber force must be able to meet steady state demands to include peacetime signaling, nuclear deterrence missions, and ongoing support to combatant commanders around the globe.
- Fourth, the bomber force must be designed in a manner that supports cost-effective operations, sustainment, and modernization.
- Fifth, given the challenges of fielding a new aircraft, the Air Force should preserve its current legacy bomber force in its entirety until guaranteed fully mission-capable new bombers are available in adequate numbers.

In today's world, the United States will go to war with the military it has, not the military leaders wished they possessed. This means that force sizing decisions must be made deliberately, based on the reality of the security environment. The circumstances the US and its allies face today and in the future demand a robust set of options. Modern military equipment, to include bombers, is highly complex. Bombers cannot be built overnight, nor can their crews be trained in a rapid fashion. Future threats require forward thinking force development. Accordingly, the future bomber force structure must cover a broad range of options for decades into the future.

The enduring influence of the 1993 Bottom-Up Review (BUR) comes from its force sizing construct. The idea that the United States must be prepared for two conflicts remains as compelling today as it was then. However, America must update its mental model of two conflicts if we wish to carry this idea into the 21st century.

The two conflict BUR model considered much smaller contingencies and did not reflect the particular threats posed by proliferating anti-access, area denial military capabilities that potential adversaries wield today. Neither did planning considerations at the time capture how the attributes of the bomber force (range, responsiveness, payload, survivability, and versatility) were expanding. These changes must be taken into consideration when addressing a two-conflict force sizing construct.

A force sized for a peer conflict plus a major regional conflict is already larger than what the Bottom-Up Review proposed for two major regional conflicts. Peer conflicts have massive target sets, powerful adversary capabilities, and the potential for significant attrition of US and allied forces. These are sobering characteristics given the relatively benign threat environment the US has enjoyed since the end of the Cold War. Recent conflicts in the Balkans, Afghanistan, and Iraq posed distinct challenges, but they did not push American capabilities and capacity to the brink. This could easily change in a future war. Nor would defeat simply be written off as unfortunate—the consequences of losing to a peer would be dire. This is

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why it is so important to develop a realistic understanding and appraisal regarding the threat environment and the associated force necessary to ensure victory against capable future adversaries.

Force Size and Composition

Similar to how an updated version of the BUR force sizing construct can help inform thinking about DOD-wide force structure needs, an updated understanding of the Air Force's Air Expeditionary Force (AEF) management construct, used instead as a force sizing concept, can point us to a bomber force structure needed to meet future security challenges.

In the 1990s, the Air Force created the AEF as a force management model to meet recurring high demand for air forces from combatant commanders, to maintain no-fly zones over Iraq and other requirements.

The AEF was designed as a means to provide required combat capability while also assuring a viable rotational base to avoid burning out personnel and equipment. To accomplish that objective required a total of 10 AEFs, with two AEFs deployed on a constant basis.

The AEF represented a well-defined package of Air Force capabilities. Each AEF was designed as a “mini air force” with numbers and types of different mission aircraft and personnel to conduct core Air Force component combat functions for the combatant commands. However, budget pressures and corresponding force structure divestitures prevented the adequate resourcing of the AEF construct, straining the viability

of the model. This was a symptom of an Air Force too small for mission taskings without commensurate resources, not a problem with the AEF as a sustainable force rotation model. The AEF construct was never used as a force sizing mechanism for the Air Force writ large (with the sole exception being its use to define the F-22 requirement during the 2001 Quadrennial Defense Review). However, the AEF stands as a viable model with applicability for sizing the Air Force in a manner that sustains combatant commander demand for power projection; personnel stability; and equipment requirements. The AEF model also offers a recognizable, historically-based foundation to understand the United States' future bomber force requirements to meet the needs of the new National Defense Strategy and a growing array of more complex and capable threats.

Considering the bomber force through the lens of the AEF model, historical use, and keeping in mind the current defense strategy, there is a baseline requirement for one squadron of 12 combat coded B-21s per AEF. This creates a requirement for 120 combat coded B-21s—or 10 operational squadrons—for forward engagement during peacetime and power projection during war. Historically, approximately 25 percent of a total force of combat aircraft is needed to support test and training operations, and another 20 percent is needed for an attrition reserve and backup aircraft inventory (BAI). These numbers result in a total requirement for 180 long-range, penetrating B-21s (120 combat coded; 30 for training; 30 for attrition reserve and BAI).

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At the same time, because of the enormous cost effectiveness of legacy bombers for a range of missions and their highly relevant and versatile capabilities, the US also needs a minimum of six non-penetrating long-range strike aircraft per AEF. This reflects mission utilization, as seen in recent operations in Iraq, Syria, and Afghanistan since 2001. These aircraft will be used as part of contingencies and war plans to conduct operations in a standoff role, or once permissive airspace is created—complicating adversary defenses. Including training, attrition reserve, and backup aircraft inventory, this requirement equates to a total legacy bomber force of 90 aircraft (60 combat coded; 15 for training; 15 for attrition reserve and BAI). This would allow for five operational bomber squadrons. Together, this rationale results in an Air Force total bomber force objective of 270 airframes, or 15 total operational bomber squadrons at 12 aircraft per squadron or 12 squadrons at 15 aircraft per squadron.⁵⁴

Looking at Air Force bomber force structure from an operational squadron perspective, today the Air Force has two squadrons tapped for conventional “workup,” or preparing for deployment; one serving as a conventional global strike force ready to employ on short notice; and another preparing to employ in a “show of force” tasking in cooperation with allies or partners around the globe as a “dual capable” conventional or nuclear strike force. One squadron is set aside solely for nuclear workup only. In addition, one squadron is deployed to US Central Command (CENTCOM), such as bombers deployed for operations against Islamic State forces in Iraq and Syria and Taliban and Al Qaeda elements in Afghanistan. Another squadron is deployed to US Indo-Pacific Command (INDOPACOM) as part of a bomber task

force providing forward presence across the vast theater. Yet another squadron is dedicated to US Strategic Command (STRATCOM) requirements. In addition, three squadrons are in reconstitution, and one is undergoing major modifications. But since there are not enough squadrons to meet requirements, one of the reconstituting squadrons is "on call" for dual-capable show of force missions, while another fills in for the global strike force requirement. Therefore, Air Force bombers today are operating in surge conditions, since eight and a half squadrons are being used to meet the actual demands of 12 bomber squadrons. Leadership and peacetime conditions have made this possible. However, if the bomber force were called upon to surge and employ against a major peer military power, the US would find that the bomber force is already operating at maximum surge capacity today.⁵⁵



Above: A visiting B-2 Spirit is towed to a parking spot at Hickam AFB, HI, one of four B-2s deployed to Andersen AFB, Guam at the time for a bomber presence rotation. One USAF bomber squadron is tapped for deployment to US Indo-Pacific Command (INDOPACOM) at any given time, according to USAF officials, in order to meet combatant commander forward presence requirements.

Several recent studies, using analysis of historical use and realistic future threat scenarios, have arrived at similar conclusions about the urgent need to increase the size of the bomber force.⁵⁶ In 2014, the Center for Strategic and Budgetary Assessments argued for a force of 174 B-21s, stating that the “increasingly non-permissive operating environments along with the shift in emphasis to the expansive Asia-Pacific region strongly suggests that even this number may be too low.”⁵⁷ In 2015, a Mitchell Institute report, *Beyond the Bomber: The New Long-Range Sensor-Shooter Aircraft and United States National Security*, concluded that a major theater conflict approximately equal in size to Operation Desert Storm would require over 250 bomber aircraft.⁵⁸ Using a variety of methodologies, Lt Gen Mike Moeller, USAF (Ret.), the former director of Air Force strategic plans and programs, contended that the US needed, “a modernized bomber force of 200 aircraft.”⁵⁹

Regardless of their specific number, each of these studies concluded that the Air Force needs a bomber force structure significantly larger than currently planned. With budget pressures a constant reality in a

world of finite resources and the global demand only increasing, the Air Force would be wise to pursue a bomber force structure strategy of maintaining its current bomber inventory while acquiring B-21s in an additive fashion. Given the present inventory of 157 B-1Bs, B-2s, and B-52s, plus the stated intention to buy a minimum of 100 B-21s, this is a rapid, viable path to achieving the capacity necessary for the future security environment. With unconstrained resources, the Air Force would simply meet its overall bomber requirement by surging B-21 production once it begins in the 2020s. However, competing demands and fiscal constraints suggest a middle course as more realistic.

Retaining legacy aircraft also serves as a prudent hedge that will ensure fully operational mission capability and capacity is available as new aircraft enter the inventory. Historically, major procurement programs have often experienced schedule slips that impact realization of full mission capability and total aircraft program buy numbers. The Air Force must be exceedingly careful that it is not acting too fast in sunseting proven bombers from its inventory, which could yield serious capability gaps. An asset like the B-2 stands alone in many of its mission functions. The B-1B's force size is also an important attribute for combat planners. Once an aircraft is slated for firm divesture at a given date, it is very challenging to extend its time in the operational inventory. The wise choice would involve incorporating some flexibility and redundancy in the bomber force management plan.

For those who cite cost as a barrier associated with sustaining the legacy bomber force as part of this plan, it is important to highlight that this approach is a matter of prudent resource management. In a defense budget where new aircraft carrier production faces repeated cost overruns in the billions of dollars, hundreds of millions of dollars can be found for increased ground force end strength, and standing up an entirely new bureaucracy to support the proposed US Space Force seems to be in the realm of the possible, it is time to ask where the US is realizing the most for its defense investment. A robust "cost per-effect" assessment would show that bombers stand as a top resource on that list. It may also be time to consider inter-DOD offsets, with less capable forms of power projection providing resources to help build the bomber force the US needs to meet its new defense strategy. The combat power realized through bomber force investment stands as one of the most cost-effective and efficient means available to provide desired capabilities across the entire engagement spectrum—from shaping regions in times of peace, projecting war-winning power in times of war, and serving as a leg of the nuclear triad.

The requirement to expand the bomber force is underscored by events as recent as the winter of 2018. Tensions with North Korea were rapidly nearing a breaking point at the time. Russia continued its revanchist behavior in both Syria and Eastern Europe. China was pursuing aggressive actions in the Asia-Pacific, and demand for US combat forces in the Middle East remained high. This amalgamation of threats was already stretching the bomber force to its very limit. Nor did this list include demands from a full-scale regional conflict, let alone a peer conflict. Secretary of Defense James Mattis characterized the dangerous global threat environment back in June 2017 when he explained:

Our challenge is characterized by a decline in the long-standing rules-based international order, bringing with it a more volatile security environment than any I have experienced during my four decades of military service.⁶⁰

The only way to successfully engage in such a world is through smart preparation to deter war, while also fielding a dominant force to win if conflict erupts.

At the same time, “steady state” demand for bombers from combatant commanders is already straining today’s limited force structure. As one Air Force leader explained: “In the last five years, [Air Force Global Strike Command] has gone from supporting one enduring COCOM [combatant commander] requirement to an average of 12 annually, a 1,100-percent increase.”⁶¹ The only way to meet such a sharp increase in demand is to add more bomber capacity. Conducting peacetime missions, to include nuclear deterrence operations, are a key additive component of sizing the bomber force. Force sizing is more than building an inventory for the needs of wartime; the force must also be responsive across the range of military operations. In addition, factors such as attrition, reserve, training, upgrade and modernization, test, and maintenance functions also impact inventory size considerations, as discussed earlier.

Despite the clear imperative for increasing the bomber force, the DOD is not aligning bomber capacity with real-world demand. There is a stated plan to retire the B-1B and B-2 fleets by the 2030s, while relying on an on time, new B-21 production schedule and B-52 modernization to field a total force of 175 bombers. The elements of Air Force Global Strike Command’s 2018 Bomber Vector released to date are cause for concern. According to the released portions of this document, it appears that B-1B and B-2

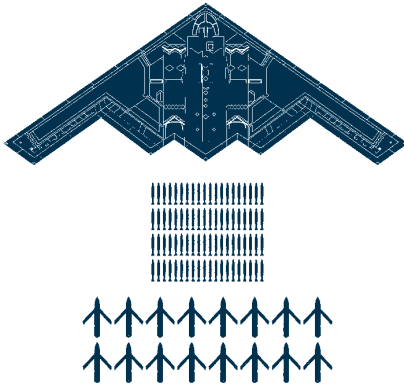
The current plan to retire the B-1B and B-2 force could incur enormous risks for the US—especially if it occurs before enough mission-capable B-21s are produced and delivered to meet growing demand.

retirements are motivated more by a desire to save money and match current manpower allocations, rather than acknowledge that growing threats are driving bomber requirements higher. If accurate, this is a dangerous path given the current state of affairs around the globe, and the reality that the bomber force built today will govern options available to American leaders for decades into the future.⁶²

The current plan to retire the B-1B and B-2 force could incur enormous risks for the US—especially if it occurs before enough mission-capable B-21s are produced and delivered to meet growing demand. If history is a guide, political factors beyond the Air Force’s control could see program delays and a premature production cessation. This would yield a topline bomber force reduction below current levels, which are already a historic low. For the last several decades, the Air Force has faced serious challenges matching actual aircraft procurement numbers to the stated requirements. 244 B-1Bs were planned, 100 were procured. B-2 production was curtailed at 21 airframes instead of the original 132. F-22 production was stopped at 187 aircraft—less than half the 381 stipulated in the official military requirement and far beneath the original number of over 700 aircraft. With the B-2 supposedly set to begin divestiture in the early 2030s and the B-1B starting to retire in 2036, the Air Force risks driving a serious capacity shortfall in America’s most cost-effective means of power projection. A quick count of operationally useful weapon stations on Air Force combat coded aircraft tells the story. This could also extend to a capability shortfall if the B-21 is not fully mission capable when the B-2 is retired, for the latter aircraft is currently the only stealthy penetrating platform in the US inventory capable of employing nuclear weapons.

Figure 5: Bombers can carry a broad range of munitions, and future upgrade potential further expands this carriage capacity.

B-2A Spirit



Notional Loadout (above):

- 80x GBU-38s (500-lb Joint Direct Attack Munition)
- or
- 16x AGM-158 JASSMs (Joint Air to Surface Standoff Munition)

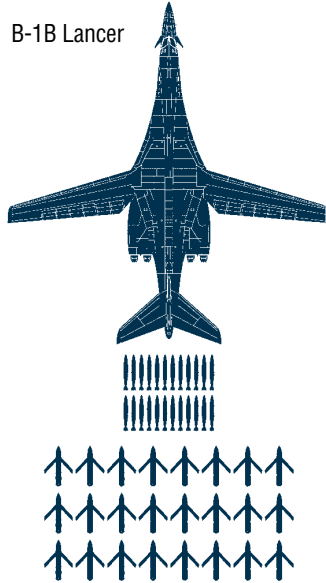
Other Loadout Options:

- 80x Mk 82s (500-lb general purpose bomb) or Mk 62s (Naval mine)
- 16x GBU-31s (2000-lb JDAM)
- 16x B61 Mod 7s (Nuclear gravity bomb; slated for replacement by B61 Mod 12) or
- B83s (Megaton-class nuclear bomb)
- 8x GBU-28s (5,000-lb Laser Guided Bomb)
- 8x B61 Mod 11s (Earth-penetrating nuclear gravity bomb)
- 2x GBU-57s (Massive Ordnance Penetrator)

Potential Future Capabilities/Loadouts:

- 192x GBU-39 SDBs (Small Diameter Bomb)
- 16x JASSM-ERs (Extended range JASSM variant; funding programmed)
- 16x LRASMs (Anti-ship JASSM variant)

B-1B Lancer



Notional Loadout (above):

- 24x GBU-31s
- or
- 24x AGM-158 JASSMs or JASSM-ERs

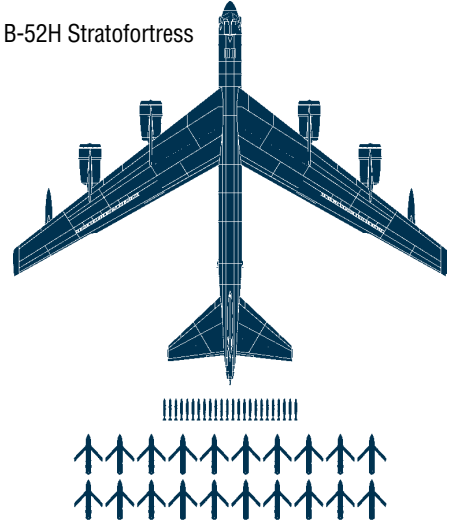
Other Loadout Options:

- 84x Mk 82s
- 84x Mk 62s
- 24x Mk 84s (2,000-lb general-purpose bomb)
- 15x GBU-38/54s (500-lb JDAM/ Laser JDAM)

Potential Future Capabilities/Loadouts:

- 96x GBU-39s (SDB)
- 48x GBU-38s (carried on multiple ejector rack)
- 40x JASSMs (with external carriage)
- 20x JASSM-ERs
- 24x Gremlins (reusable RPAs; DARPA development program)

B-52H Stratofortress



Notional Loadout (above):

- 24x GBU-38/54s (500-lb JDAM)
- or
- 20x JASSMs

Other Loadout Options:

- 45x Mk 82s
- 10x GBU-10/12s (2,000/500-lb LGB)
- 20x AGM-86Cs CALCMs (conventional air-launched cruise missile)
- 20 AGM-86B ALCMs (Nuclear cruise missiles; 12 on external pods and 8 internally)
- 24x ADM-160 MALDs (Miniature Air-Launched Decoy)

Potential Future Capabilities/Loadouts:

- 92x GBU-38/54s (with internal smart rack upgrade and external multiple ejector rack)
- 80x GBU-39 SDBs
- 78x GBU-38/54s (with internal smart rack upgrade)
- 34x MALD/MALD-Js (MALD and MALD jammer, with internal smart rack and external pylons)
- 24x JASSMs (with heavy stores pylon)
- 24 GBU-31s (with heavy stores pylon)

Sources: US Air Force and Jane's All the World's Aircraft. Artwork: FoxbatGraphics.

It is difficult to overstate the risk incurred by divesting nearly 100 legacy bombers before ensuring the first tranche of 100 B-21s is complete. Given the number of competing recapitalization programs in the mix—F-35, B-21, the E-8 JSTARS replacement, T-X, the KC-46 tanker, the UH-1 replacement, combat rescue helicopter, ground based strategic deterrent (GBSD), continued MQ-9 Reaper remotely piloted aircraft investment, and over ten major satellite constellations—the pressure on future acquisition budgets will be significant. Given how long modernization for most of these mission areas has been delayed, it is no exaggeration to state that the recapitalization of each program is vital.

With the inherent speed of the B-1B, stealth of the B-2, oversized and standoff payload carriage capability of the B-52, and the long range and large arsenal of all three, today's bombers can respond across spectrum of conflict.

Maintaining the current bomber force mix is the smart thing to do. The legacy bombers are bought and paid for, so costs are limited to modernization and sustainment. While bombers, particularly stealth bombers, may appear expensive at the unit level in terms of “cost per flying hour,” they offer superior value across their lifespans when additional factors such as supporting operations and munitions are factored into the equation. As was previously discussed, cost per desired mean point of impact (DMPI) is likely a far more relevant metric for assessing the relative value of strike systems. With the inherent speed of the B-1B, stealth of the B-2, oversized and standoff payload carriage capability of the B-52, and the long range and large arsenal of all three, today's bombers can respond across spectrum of conflict. This is a set

of capabilities that needs to be preserved until comparable means are available to deliver like effects. These airframes have also benefited greatly from a series of upgrades over several years. In the case of the B-1B, this includes cockpit modernization, radar upgrades, new carriage capability for additional munitions, and Link 16 data link capability. B-2s have benefited from radar upgrades, enhanced communication capabilities, a new bomb rack capable of mounting 80 JDAMs, and continual low observable signature improvements. B-52s are now on a modernized data link network thanks to the CONECT (Combat Network Communications Technology) program, can carry 67 percent more weapons due to rotary launcher upgrades, are in the process of upgrading to an AESA radar, and are in the beginning stages of a re-engining program.

It is also important to note that while little is known about the B-21 due to classification, the aircraft may not be nuclear capable during its initial fielding. If this is the case, the B-2 must not be divested before the B-21 is nuclear certified—due to its vital duties as part of the air-breathing leg of the nuclear triad. The risk to US national security is simply too great to allow such a gap to occur.

While some aspects of the legacy bomber force will not be as capable as the new B-21 when measured against the most challenging threats, the past three decades have been filled with a variety of contingencies requiring a broad range of capabilities. There is no reason to think the future will not be similar. For mission requirements like those experienced during Operations Inherent Resolve, Odyssey Dawn, Odyssey Lightning, and Enduring Freedom, the threat environment and mission parameters do not demand employment of the most advanced technologies. Commanders will continue to need aircraft with the attributes possessed by the legacy bomber force. The same is true for daily force presence missions in Europe and the Asia-Pacific regions.

It is worth recalling that in the days before the summit between North Korea's Kim Jong Un and US President Donald Trump, B-52 exercises were called off because they were perceived as too threatening. Even though the youngest B-52 is over 50 years old, its combat power is still viewed by adversaries as a force to be reckoned with.⁶³ The power projected by newer aircraft like the B-2, and soon the B-21, simply bolsters the power of bomber-delivered deterrence. This is why the Air Force would be best served to prudently manage risk and grow its bomber force by retaining the aircraft it currently has in its inventory—the B-1B, B-2, and B-52— while adding new B-21s to the force until the bomber objective force of 270 aircraft is reached. Failing to do so risks the vitality of one of the most potent power projection toolkits available in the entire US arsenal.

Operations and Sustainment

This bomber force will not be sustainable unless it incorporates the lessons learned from past experiences—namely, to avoid the creation of small aircraft fleets. Bomber inventories will yield far more favorable sustainment costs if they are operated with the benefit of large fleet dynamics. This is especially important for the Air Force to consider as it seeks to maximize the sustainability of the B-21. The reason is quite simple: larger aircraft purchases are more economical to sustain over their lifetimes because they benefit from economies of scale amortizing the fixed costs associated with “owning” an aircraft. This includes maintenance, personnel, and depot overhead that does not depend on how often or when aircrews fly the jet.

Additionally, when looking to grow the bomber force, it is important that Congress and the Air Force prioritize stable and robust funding levels. Funding instability can have extreme effects on a program's overall health—whether looking at a new initiative like the B-21 or legacy bomber upgrades. The effects of sequestration cuts, prompted by the Budget Control Act, are still being felt across the DOD with aviation accounts encountering particularly acute problems. In years of budget shortfalls, maintenance is deferred, and modernization programs postponed. When maintenance funds are finally made available, the effects of deferring repairs compounds dangerously. When modernization programs are finally restarted, they often experience cost and schedule growth. The lesson of the past several years is clear. Robust and sustained funding is absolutely vital for the continued health of existing aircraft fleets.

Finally, the Air Force needs to aggressively make a cost-efficiency-based case when advocating for bomber resources. This is a concept that can also be termed “mission-based affordability.” Fundamentally, cost per desired effect is the key metric when advocating for resources, and assessments should be made across DOD, not just within military service or mission-set stove pipes. While bombers may appear to be high cost systems based on measures of merit focused on operating expenditures per individual unit, they may in fact be the most capable, cost-effective option when evaluated across all DOD power projection options. Pragmatically the DOD and the services must comply with budget direction received by the Office of Management and Budget (OMB). However, optimizing the entire US military's combat power requires portfolio trades to be made across the totality of the DOD enterprise. If the Air Force does not advocate and articulate the value of its capabilities relative to other service component options, no other organization will. While bombers have a comparatively high per-unit operating cost, the operational effectiveness and efficiency realized by these aircraft in creating power projection effects affords superior value when compared to alternatives.

Recommendations

The considerations and insights put forth in this study inform the following recommendations to increase the capability and capacity of America's long-range bomber force:

1. **B-21 Acquisition:** The Air Force should aim to procure at least 180 B-21s. When this initial tranche of aircraft is filled, Air Force officials can either continue to buy additional aircraft to build to a fully fifth generation bomber force or consider a revised design that would eventually retire legacy bombers in favor of modern aircraft.⁶⁴

To build the force structure needed for the 21st century, the Air Force should consider retaining and modernizing its legacy force of B-1Bs and B-2s until it can procure B-21s in larger numbers and key mission capability and capacity parameters are met.

2. **Bomber Retirements:** To build the force structure needed for the 21st century, the Air Force should consider retaining and modernizing its legacy force of B-1Bs and B-2s until it can procure B-21s in larger numbers and key mission capability and capacity parameters are met. This additive approach, in combination with the stated intent to retain and modernize the B-52, builds the bomber inventory, closing the gap between demand and available assets in an era when range, responsiveness, payload, survivability, and versatility matter more than ever.

3. **Modernization:** All legacy bomber types must be modernized to afford continued operational reliability for several more decades. For the B-1B, this includes radar modernization, structural assessment, defensive systems, and a continued broadening of its weapons portfolio. B-52 modernization includes a new AESA radar, reengining, and other programs as the Air Force looks to make this platform a standoff companion to the B-21. From a historic perspective, reengining has provided increases in capability while also freeing up tanker support for use on other missions. For the B-2, upgrades should no longer focus on expensive, long technology development timelines. Instead, B-2 modernization should focus on integrating existing technology to lower cost and shrinking timelines while maximizing the lethality of the B-2 in the most stressing scenarios. This should include a modernized defensive management system, adding fully integrated satellite communications capabilities, expanded weapons carriage, and upgraded radar processing to enable key missions like maritime strike. It should also be noted that the B-1B, B-2, and B-52 have a significant percentage of their physical lifespan remaining.

4. **Fleet Management:** To make retirement pronouncements today about decisions that will be made in the 2030s is counterproductive. One need only look at decisions made regarding the U-2, RQ-4 Global Hawk, E-8 JSTARS, the A-10, and other aircraft. Once an aircraft is labeled as bound for retirement, modernization dollars disappear. When circumstances change, and an aircraft's service life is extended, a surge of funding is required to bring the enterprise back up to a full operational

level and vital modernization efforts may get out prioritized. This overly prescriptive approach to inventory management is not only expensive but also highly inefficient.

5. **Networking:** Every bomber must be connected as critical elements of the combat cloud, to facilitate rapid and seamless data gathering, processing, and dissemination across platforms and domains. With readily available size, weight, and power, bombers have enormous potential for operating as key nodes in the distributed, decentralized future combat cloud architecture.
6. **New Missions:** Bomber missions must expand beyond long-range air-to-ground strategic attack and interdiction. For example, bombers have proven maritime strike capabilities. Test efforts with the Long-Range Anti-Ship Missile (LRASM) conducted with the B-1B in March 2018 demonstrate their potential in this role.⁶⁵ In addition, the B-21 and B-2 could fly even closer to enemy surface combatant ships, and be outfitted with smaller, shorter-range anti-ship weapons. Radar and processor upgrades can also allow bombers to execute certain functions of the air defense mission. This combined with their tremendous weapons load could make them especially useful for engaging large raids of cruise missiles or enemy aircraft. Finally, all bombers must be viewed as sensor-shooter-effectors. The value this affords in increasing situational awareness and shortening the kill chain is tremendous. Additionally, penetrating bombers will prove most useful in gathering situational awareness behind enemy lines when conventional ISR aircraft will be unable to transit defended enemy air space. Upgrade priorities, funding levels, and general force management decisions must appreciate all these strengths, not just the traditional bomber long-range air-to-ground strategic attack and interdiction missions.
7. **Weapons:** Future weapons development, especially with hypersonic, directed energy, and cyber-attack weapons, will likely gain significant operational advantage if these capabilities are paired with the bomber's weapons carriage attributes, ability to transit long distances, persist in areas of interest, and in the case of the B-2 and B-21, penetrate defended regions. The B-52, the aircraft that successfully carried the X-15 hypersonic test aircraft in the 1960s, may become a hypersonic missile launch platform by the middle of the 2020s. Future bomber inventory assessments should factor in an increase in mission demand for long-range strike aircraft based upon advanced technology developments and maturation.
8. **New Metrics:** The DOD must establish a new set of metrics to determine mission system value on a normalized "cost per effect" or mission-based affordability vantage basis. The Deputy Assistant Secretary of Defense for Strategy and Force Development and the Office of Cost Assessment and Program Evaluation (CAPE) must then be empowered to enforce this trade space across the Department to ensure that budgets are producing the desired capability outputs in the most cost-

Every bomber must be connected as critical elements of the combat cloud, to facilitate rapid and seamless data gathering, processing, and dissemination across platforms and domains.

effective manner possible. An example of how such an approach would work is to normalize the total enterprise cost involved in putting a bomb on target for a range of platforms, and then the cost of sustaining that capability over a given period. It is well past time to start measuring real mission enterprise cost as a result of output delivered relative to total enterprise costs.

- 9. Aircraft Readiness:** Readiness accounts must be robustly funded on a continual basis. While funding can and should be directed to airframe enhancements that improve the mission capable rate of a given platform, there is no greater determinant of aircraft readiness than steady and predictable operations and sustainment funding. An aircraft's fundamental health is tied to how well it is sustained and maintained. Funding shortfalls in this vein will obviously drive availability numbers that are less than optimal. However, the actual driver needs to be properly assessed—it is often a funding deficit and not the aircraft themselves. It is useful to recall that in the 1990s, the B-1B fleet suffered from poor readiness levels. Congress grew interested in this issue and directed a test whereby between June 1, 1994 and November 30, 1994 a readiness assessment was executed to see if the B-1B could attain a 75 percent operational readiness rate. The test wing achieved 84 percent when the rest of the B-1B fleet was at 65 percent. The differentiator was aligning resources with real-world demand—by improving maintenance staffing, increasing spare parts availability, and addressing other sustainment concerns.⁶⁶

Conclusion

The value that bombers present to the United States is second to none. Whether creating diplomatic effects through a presence mission, spanning the globe to deliver combat effects, or standing at the ready as an integral element of the nuclear triad, these aircraft are extraordinarily valuable combat assets. In many ways, their utility is so great that institutionally some view these aircraft as a parochial threat to traditional weapon systems, for when an honest comparison is made on a cost per effects basis, few can rival the efficiency and potency of the bomber. Gen Brent Scowcroft, USAF (Ret.), who served as national security advisor during the George H.W. Bush Administration, observed this reality in a 1997 report looking at the future of the B-2 program:

Overall the bomber force and the B-2 in particular has suffered from two major problems. First, it has lost any institutional, bureaucratic advocate with the demise of Strategic Air Command. Support for the B-2 means that something else must suffer—and no institutional champion or leader has emerged to lead that struggle. Second, support for the B-2 inherently means recognition of a revolutionary new form of warfare which threatens all other services and non-bomber interest groups. Affirming the B-2 ultimately implies major changes in strategy, in service budget shares, in service size and manpower, and in strongly held personal convictions.⁶⁷

While Scowcroft's observation was made in a different era and involved different circumstances from today, his macro-level conclusions remain valid. Securing warfighting options wisely, not inflexible dedication to a rigid set of traditional strategies or parochial priorities is what matters.

Going back to the early days of airpower during the 1920s and 1930s, airmen like Billy Mitchell and Frank Andrews had to battle against their counterparts in the Navy and Army for resources to build the early bomber fleets. The anti-airpower biases these airmen had to fight against was firmly entrenched. However, airpower proved its worth at the tactical, operational, and strategic levels during World War II. German close air support, Japanese naval aviation, and American strategic bombing created revolutionary effects that dramatically shaped the course of the war. It was airpower, and bombers in particular, that delivered the final blows of the conflict when atomic weapons were dropped on Japan, and in so doing ushered in the nuclear era.

Bombers continued to be a key element of US national security strategy throughout the Cold War, serving as the most flexible leg of the triad. The fact that nuclear war never erupted during this period is a testament to the effectiveness of this strategy and the airplanes that empowered it. However, it was not until the advent of precision munitions and their widespread use that bombers became the epitome of power projection. Low-observable technology only increases the efficacy of these mighty aircraft by affording a level of survivability wholly unimagined by past generations.

Oddly, the bomber's effectiveness and efficiency continue to be its Achilles heel. Other service branches and mission areas continue to perceive the bomber as a threat to their respective bureaucratic turf. If the

information is presented and assessed in an impartial, balanced fashion, it is hard to argue against the value of these aircraft. This is not to say that other forms of power projection are not valuable, but the ability to target over 80 precision guided munitions off a single aircraft that can reach anywhere in the world in a matter of hours and sustain long-duration missions is an asymmetric advantage for the United States. Limiting factors are not inherent within the aircraft themselves, but instead relate to items like spare parts, munitions availability, and crew rest.

The post-Cold War drawdown of bombers means that today there simply are not many remaining bomber installations. They are now permanently based only in five locations; Louisiana, Missouri, Texas, South Dakota, and North Dakota. It has been two decades since a new bomber rolled off a production line. This means that there are only five states with members of Congress strongly advocating for these aircraft.

With military budgets not likely to rise significantly in the foreseeable future, it is time for defense officials, members of Congress, and leaders in the broader policy and budget community to seriously consider defense priorities that focus on how to best project combat power in the most cost-effective and efficient manner possible.

Accordingly, this results in much less Congressional support for bombers relative to other weapon systems and operating concepts with widespread presence among Congressional districts.

Throughout the 1990s and early 2000s, the United States was quite secure as the world's dominant power. Military campaigns from that period were conducted against adversaries with few military capabilities comparable to today's threats. With China and Russia pushing forward aggressively with advanced weapons development and new concepts of engagement, smaller nations like North Korea and Iran fielding military capabilities once reserved for superpowers, and the threat of radical extremist terrorism seemingly unending, the security environment is much more complex and dangerous than when the current bomber force numbers were established.

With military budgets not likely to rise significantly in the foreseeable future, it is time for defense officials, members of Congress, and leaders in the broader policy and budget community to seriously

consider defense priorities that focus on how to best project combat power in the most cost-effective and efficient manner possible. This is a fundamentally different approach than balancing priorities to preserve bureaucratic equities, or favor courses of action for political reasons. The reality is that America faces a very dangerous future and its security fundamentally depends on making smart decisions that yield the best value in providing combat options. Americans have not had to think like this in decades because the country's existential interests have not been threatened in a serious fashion since the collapse of the Soviet Union. Circumstances are now different. While the citizenry may be slow to realize these changes, those in positions of power understand that threats to US security interests are growing, and priorities need to match these new conditions.

The argument for bombers is not one made for political or parochial reasons. The facts very plainly support the need to grow America's bomber force. It is time to capitalize upon the advantages they afford the

nation and get serious about matching real world requirements to necessary force structure. As Gen Chuck Horner, USAF (Ret.) explained in testimony back in 1996, “Instead of reshaping our military to exploit our strengths and shore up our weakness, we’ve simply shrunk the Cold War force, downsizing it without ‘rightsizing’ it. The result is a force ill-equipped to meet the challenges of the future.”⁶⁸ He was right when he made that statement over 20 years ago, and it is just as accurate today. As noted airpower analyst Barry Watts once remarked: “Why would the United States not want a robust capability to hold targets deep in the enemy heartland at risk and impose the costs of trying to defense targets there?”⁶⁹ This is still a pertinent question and one the Department of Defense must answer as it seeks to chart a path forward regarding the nation’s long-range sensor-shooter aircraft portfolio. Leaders are fortunate that a viable path is at hand to build a bomber force structure to meet the needs of the US’ national security strategy by retaining the B-52, B-1B, and B-2 while adding the B-21. It is time to grow America’s bomber force for the rest of the 21st century, to meet the challenges of an era of renewed strategic competition. ★

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Above: (From left to right) A B-52, B-1B, and B-2 fly near Barksdale AFB, LA on February 2, 2017, participating in a commemorative flyover marking the Eighth Air Force's 75th anniversary. Former and present Airmen celebrated the anniversary by holding various events to honor the past, present, and future of the "Mighty Eighth."



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