

MITCHELL INSTITUTE
for Aerospace Studies



Understanding the B-21 Raider

America's Deterrence Bomber

Mark Gunzinger
Director of Future Concepts and
Capability Assessments



DOD's strike forces are sized and shaped for regional conflicts of the past

“To prevail in conflict...DOD will prioritize a future force that is lethal: possesses A2/AD-insensitive strike capabilities that can penetrate enemy defenses at range” *2022 National Defense Strategy*

Recommendations to maintain a decisive strike advantage

- 1. Increase the range, payload capacity, and survivability of our combat air forces.** DOD's combat air forces are over-balanced toward shorter-range, 4th generation and earlier aircraft; more range, payload capacity, survivability needed to deter PLA aggression
- 2. Rebuilding long-range strike capacity for peer conflict will require prioritizing cost-effective capabilities.** Analyses have repeatedly shown penetrating bombers are the more cost-effective means to strike large target sets—possibly 100,000 or more aimpoints in a peer conflict—over long ranges in contested environments



Recommendations (continued)

3. **The future U.S. triad must deter 2 nuclear peer adversaries.** Our triad is sized to deter Russia, not two nuclear peers – fielding a larger force of dual-capable B-21s would be a “two-for-one” approach to increasing triad capacity and enhancing deterrence across the conflict spectrum
4. **A 300-plus bomber force with at least 225 penetrating B-21s is needed.** The capacity to sustain overwhelming strikes that rapidly attrit highly mobile enemy forces will be critical to defeating an invasion of Taiwan and deterring opportunistic aggression in another theater
5. **Robust B-21 acquisition—20 per year or more at full scale production—is critical to deterring China.** The PLA’s modernization is on pace to prepare it for a campaign to seize Taiwan by 2027 – throttling B-21 acquisition rate over the next decade will increase the risk of a conflict and result in costs that exceed any temporary program savings

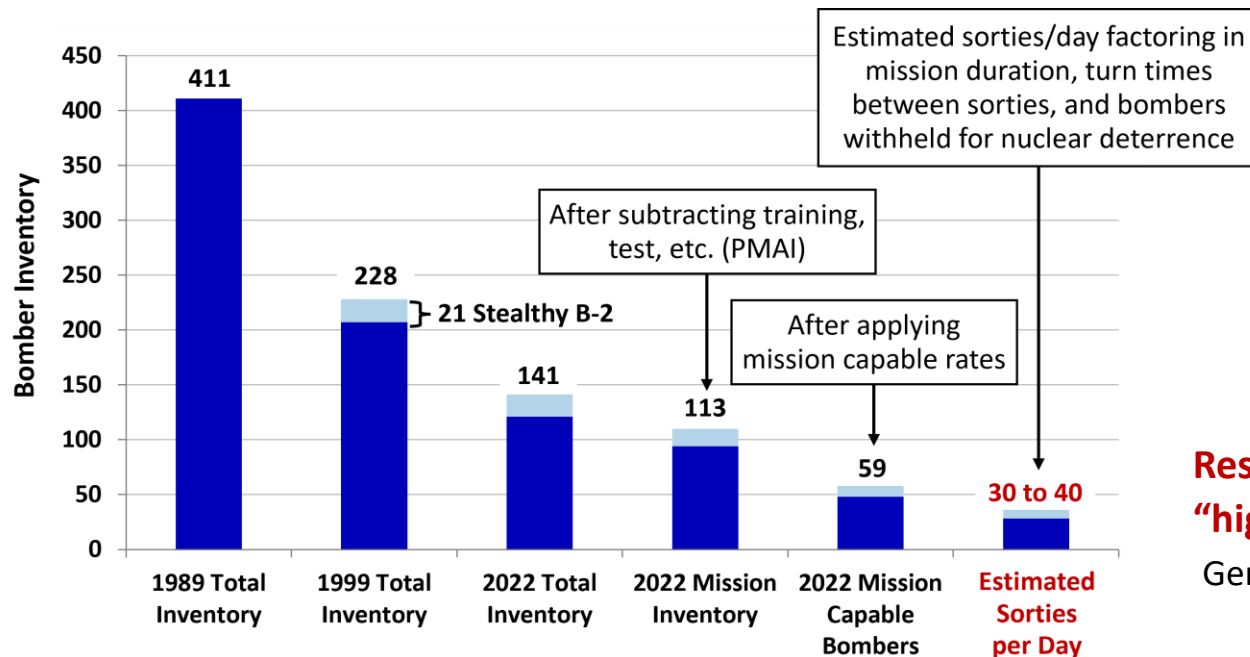


What's the problem?

Understanding the 2023 bomber force

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

- **30 years of budget-driven cuts reduced bomber inventory to about 1/3 Cold War level**
Traded “capacity for capabilities,” used savings from force cuts to sustain smaller fleet (this approach continues today)
- **Cuts not accompanied by declines in COCOM operational demands for long-range strike**
- **Today's smaller force translates to 30-40 sorties per day, counting 6-8 B-2 sorties**
Not enough capacity to credibly deter or respond to a 2nd crisis



Result: Bomber inventory is now a “high-demand/low-density force”

Gen Bussiere, AF Global Strike Command



Maintaining our precision strike advantage

Must increase range & weapons payload capacity

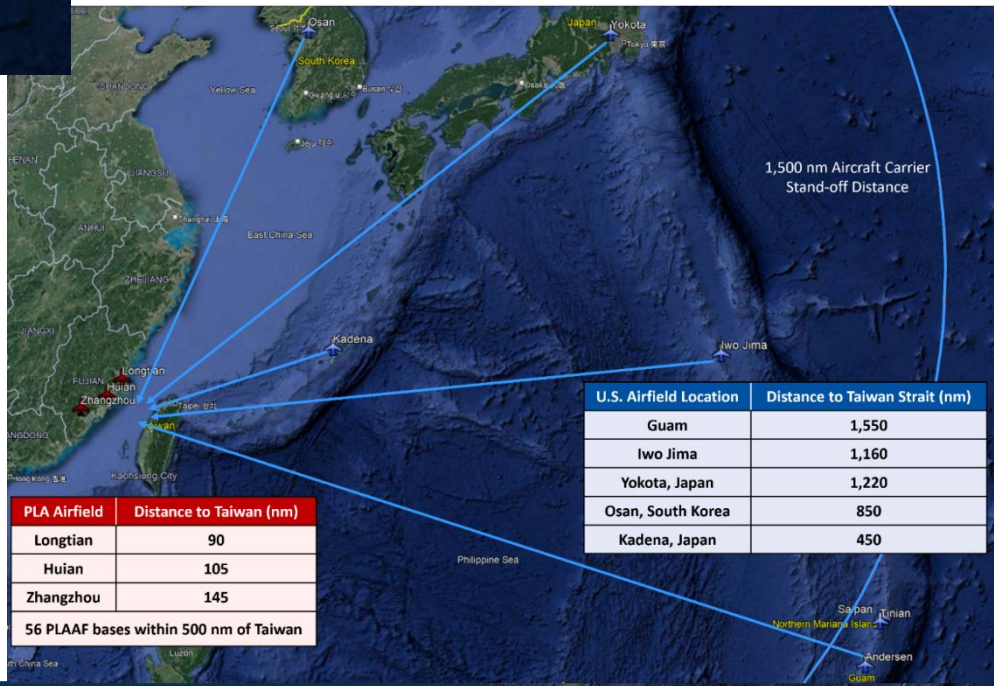


PLA has “home field” advantages

- More bases, closer proximity to battlespace, can disperse and move forces on mainland, offensive operations covered by land & sea-based air defenses (advantages in **survivability, sustainment**)
- Shorter flight times to and from battlespace, increase sortie generation potential per day, can use short-range surface-to-surface missiles (advantages in **time and combat mass**)

Capabilities to defeat a PLA *fait accompli*

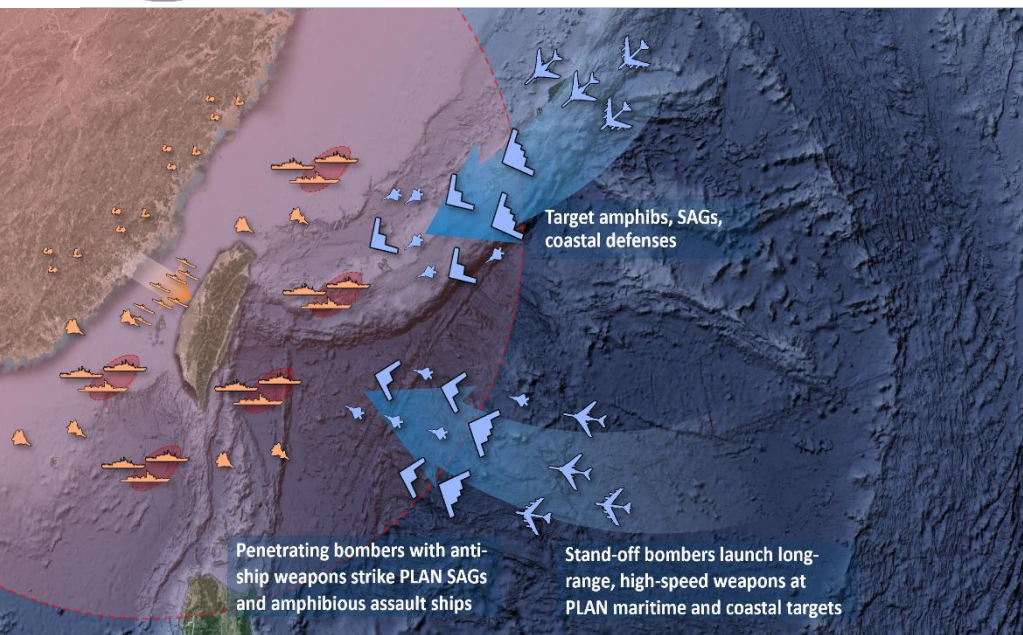
- Forces that can rapidly respond and take the offensive to the PLA in hours, not days or weeks
- Increased range and mission persistence to overcome tyranny of distance
- More weapons per sortie (targets per sortie)
- Operate in environments that will remain highly contested
- Force that increase basing options – able to operate from more distant bases at reduced risk of high-density air and missile attacks





Maintaining our precision strike advantage

Must increase capacity to strike mobile targets



- Blunt/deny target sets could largely consist of highly mobile forces
 - Amphib landing ships, support craft, surface action groups (SAGs), air defense sensors, coastal SAMs
- Bombers will be the foundation for a *fait accompli* denial – no other force can provide required mass + precision at range
 - Aircraft carriers standing off 1,500 nm cannot generate enough sorties, fighters have smaller payloads

FIXED TARGETS



Hard and Deeply Buried

MOBILE TARGETS



Figure adapted from an Air Force briefing on future weapon requirements

If You Want To:

Deny, Blunt

Mobile 90%

Fixed 10%

If You Want To:

Invade, Defeat, Dislodge

Mobile 20%

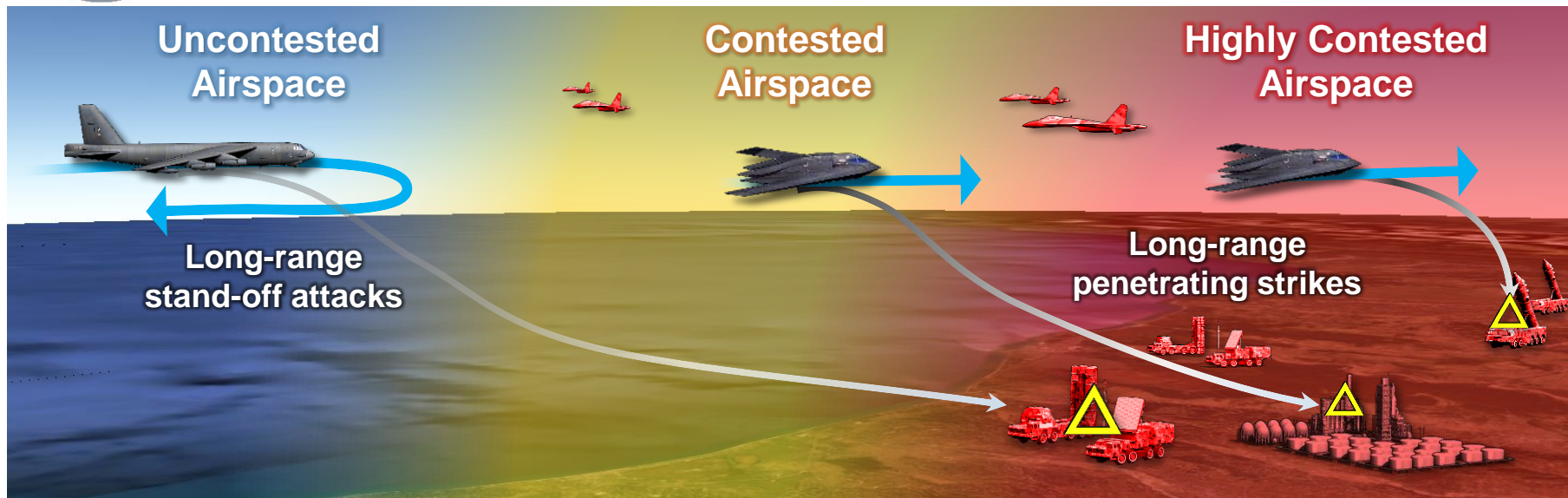
Fixed 80%

- Attack subs have limited weapon magazines, cannot replenish at sea
- Very long-range surface-to-surface weapons are large, expensive, and have longer flight times that can reduce their effectiveness against mobile targets

For any number of reasons, any number of these can become **TIME SENSITIVE**



Only Air Force bombers have this mix of capabilities – they are the foundation of a *fait accompli* defeat force



B-52, B-1

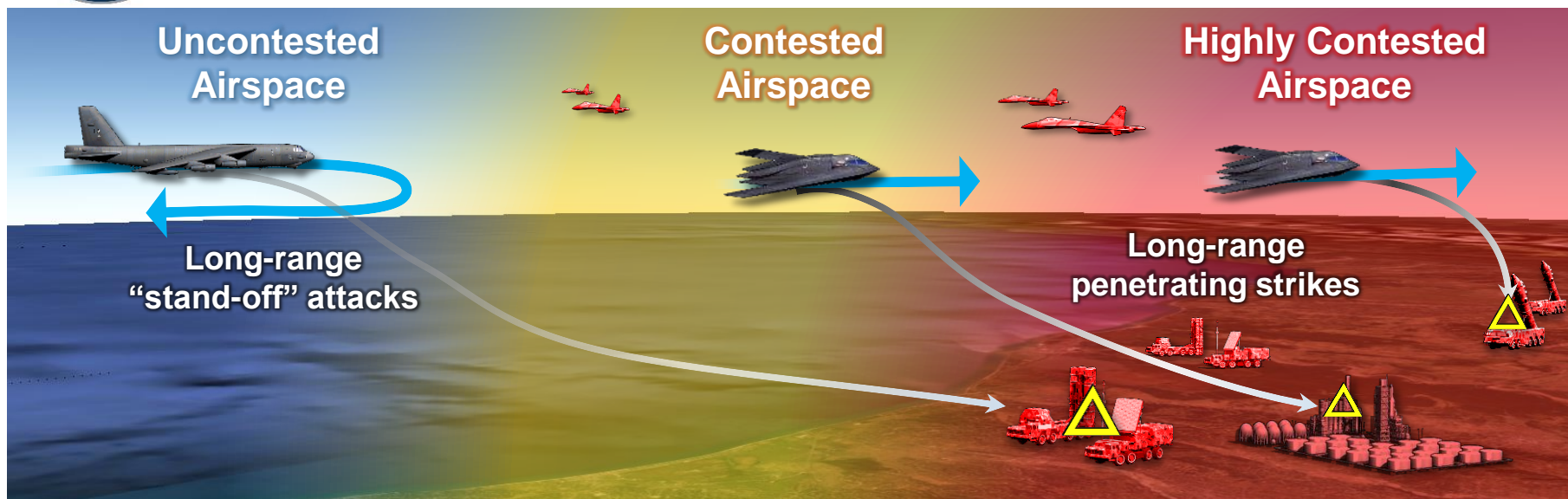
- Intercontinental ranges, able to operate from more distant “access insensitive” bases
- Long duration missions
- Large payloads (B-52 can carry 20 JASSM, B-1 can carry 24 JASSM)
- Survivable from stand-off distances
- Multi-mission capable (strike, maritime strike, close air support, etc.), part of B-52H fleet nuclear capable

B-2, B-21

- Intercontinental ranges, operate from more distant “access insensitive” bases
- Long duration missions
- Large payloads (B-2 can carry up to 80 500 lb-class munitions)
- All-aspect, broadband low observability, smart mission planning to optimize survivability, sensor fusion
- Multi-mission capable (strike, maritime strike, close air support, nuclear capable, etc.)



B-21s will increase theater commander options, there is no “plan B” without them



- Range unmatched by any other combat aircraft
- Next-gen stealth to penetrate highly contested environments
 - Advanced radar-absorbing materials, more computing power, ability to fuse multiple sources of threat information, software that optimizes its flight path to minimize exposure to threats
- Most maintainable bomber ever, including its low observability
- Designed with an open system architecture, adaptable and upgradeable over time with new weapons and other advanced technologies as they mature

“No other long-range bomber can match its efficiency. It won't need to be based in-theater.”

“Even the most sophisticated air-defense systems will struggle to detect a B-21 in the sky.”

Secretary of Defense
Lloyd J. Austin III



Maintaining our precision strike advantage

Must develop the right mix of future weapons



- Target set in a major peer conflict could include **100,000** or more aimpoints
- **Strike the right balance between munitions for long-range stand-off & penetrating strikes** (both are needed, the issue is creating the right mix)
- **Right-size munitions to maximize payloads** (increase weapons per sortie, also reduces sorties and time to strike required targets)
- **Prioritize weapon cost effectiveness—cost/kill** (penetrating strikes have the advantage)



Prioritizing cost-effective munitions will help DOD to develop large inventories needed for peer conflicts



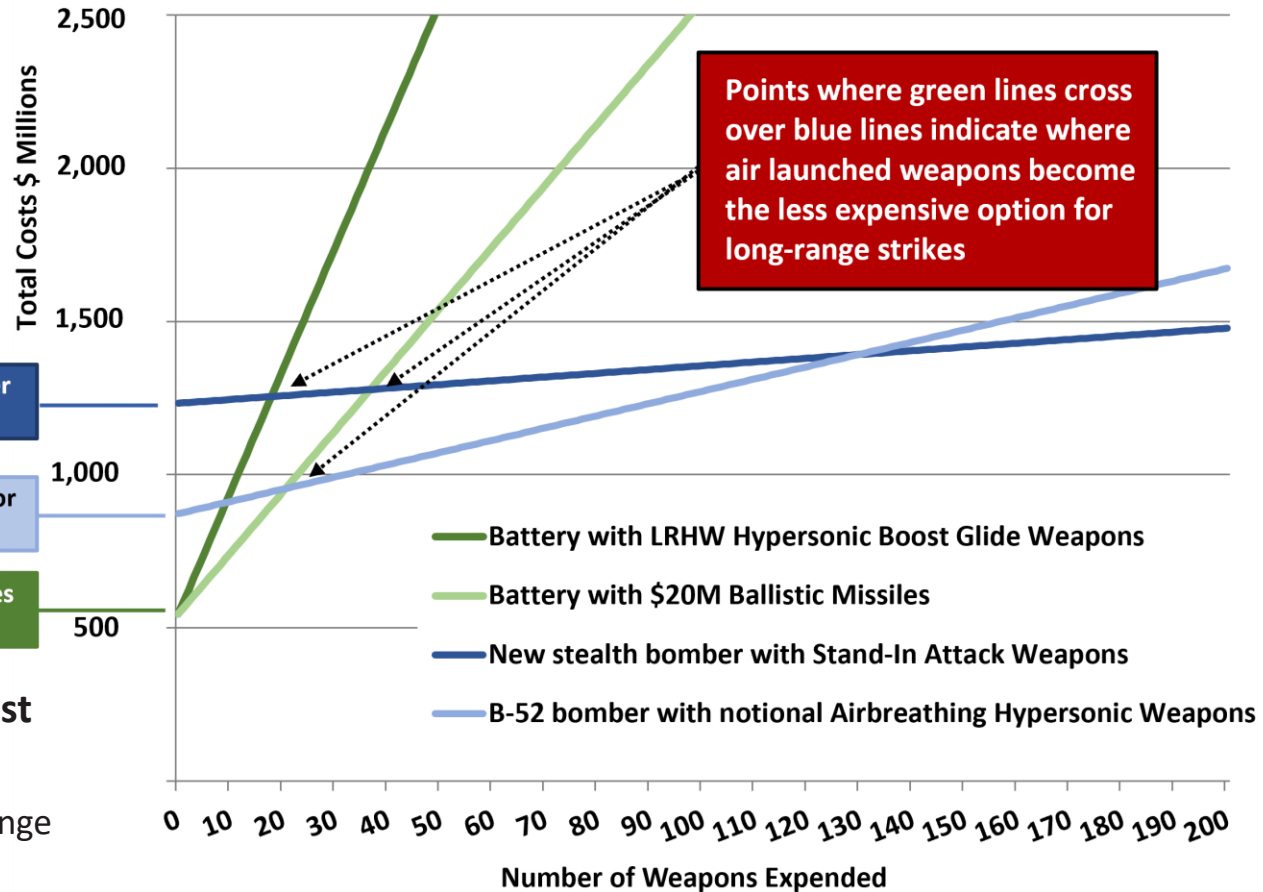
Starting point: cost to acquire a new stealth bomber then operate and sustain it for 30 years

Starting point: Cost to operate and sustain a B-52 for 30 years (B-52 acquisition not included)

Starting point: cost to acquire a new long-range fires battery then operate and sustain it for 30 years

Weapon features that increase cost

- Propulsion units, datalinks, guidance systems, other capabilities for long-range flight (size also varies with range)
- Higher speeds (hypersonic) to reduce flight times over long ranges
- Active/passive sensors to find targets that have relocated while weapon inflight



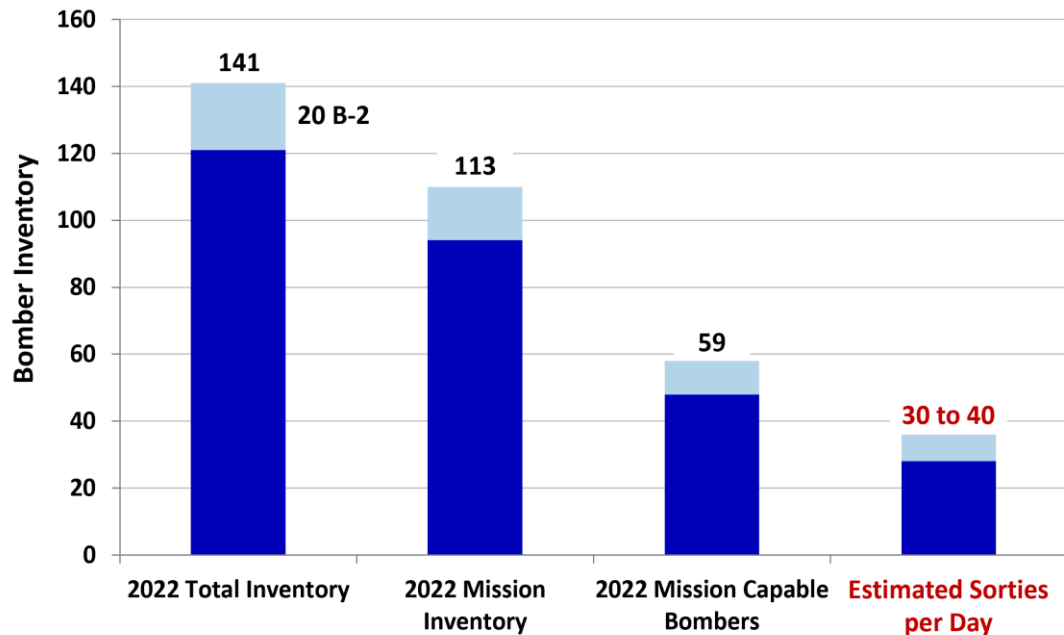
Points where green lines cross over blue lines indicate where air launched weapons become the less expensive option for long-range strikes

Advantage: Penetrating Bombers

Can use smaller, shorter-range PGMs with reduced flight times to mobile targets; smaller weapons = more targets per sortie; penetrating bombers have range to attack deep targets out of reach of current stand-off weapons



Size the bomber force to meet warfighting requirements, not available budget



- 225 B-21s and 75 B-52s would more than triple potential weapons capacity at range compared to current inventory
- This is not excessive – may have to strike 100,000-plus aimpoints in a peer conflict and do so rapidly
- Periodic “pulsed” strikes and other forms of gradualism driven by insufficient forces create opportunities for the adversary

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

Assumes no bombers are withheld for other theaters and nuclear deterrence



Capacity matters: size the future bomber force for two wars

- **Why a two-war bomber force?**
 - Until 2018, DOD sized its forces to deter or respond to a second conflict...the risk of a second crisis continues to grow, not diminish
 - Only bombers have the long ranges, short response times, and large payloads to blunt then deny invading forces in two theaters and “swing” between theaters if necessary
 - Would also enhance deterrence against other threats including nuclear attacks
- **Size to defeat a PLA campaign in the Indo-Pacific and deter/defeat an opportunistic aggressor in another theater**
- **Must also size for attrition (no attrition reserve today) and nuclear deterrence (additive national requirement)**

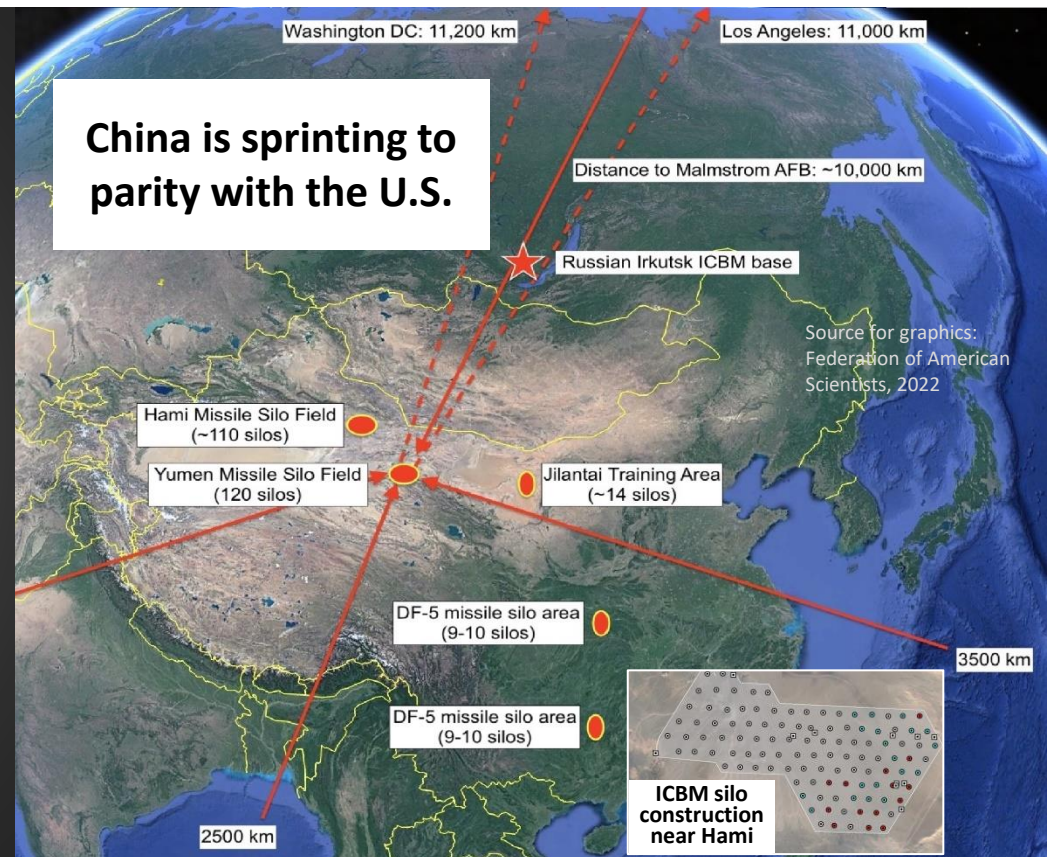
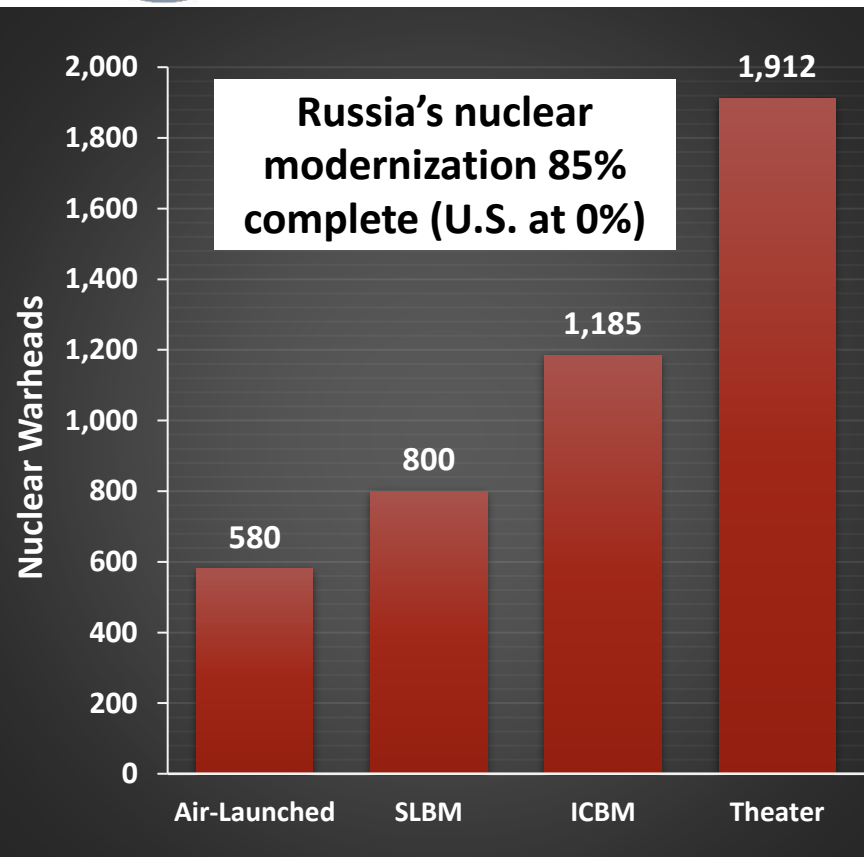


The Air Force is now 5 bomber squadrons short for one peer conflict plus deterrence (“The Air Force We Need”)





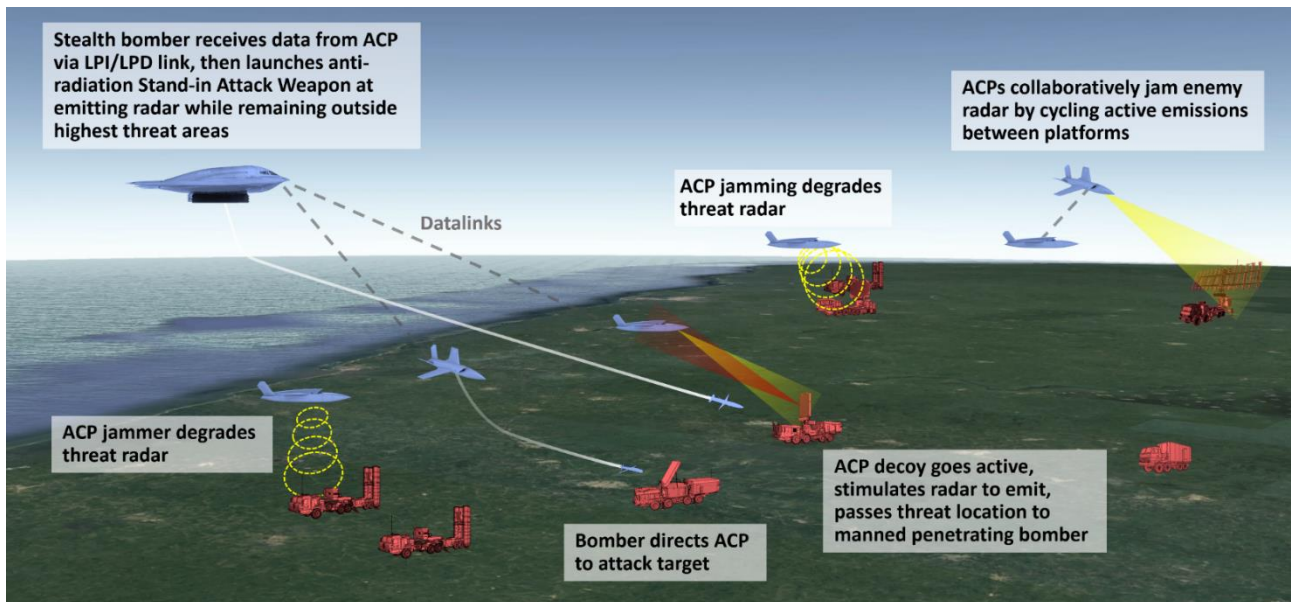
Must also deter two peer nuclear competitors: dual-capable B-21s are the most cost-effective option



- U.S. triad is sized for a single nuclear competitor – Russia
- Russia's conventional military is weakened "which will likely increase Moscow's reliance on nuclear weapons" (2022 U.S. National Security Strategy)
- China is in a "strategic breakout" – building 3 new ICBM silo fields deep in its interior and out of reach of current U.S. stand-off weapons, ICBM count already outnumbers ours



The Air Force designed its B-21 development approach to help maximize fleet size



- **Family of systems long-range strike force design:** Offload some capabilities to other systems, reduce B-21 cost
- **Took advantage of mature technologies and systems** (less an invention than the B-2)
- **Established cost as a key performance parameter**
- **Balanced capability tradeoffs** to ensure B-21s can be acquired at scale

Notional Bomber Cost Comparison (FY 2010 \$)

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

Unit cost is not the right metric, fielding a larger fleet is. Why? Need more capacity (sorties) for large target sets dispersed over very large areas (Indo-Pac); also need simultaneity



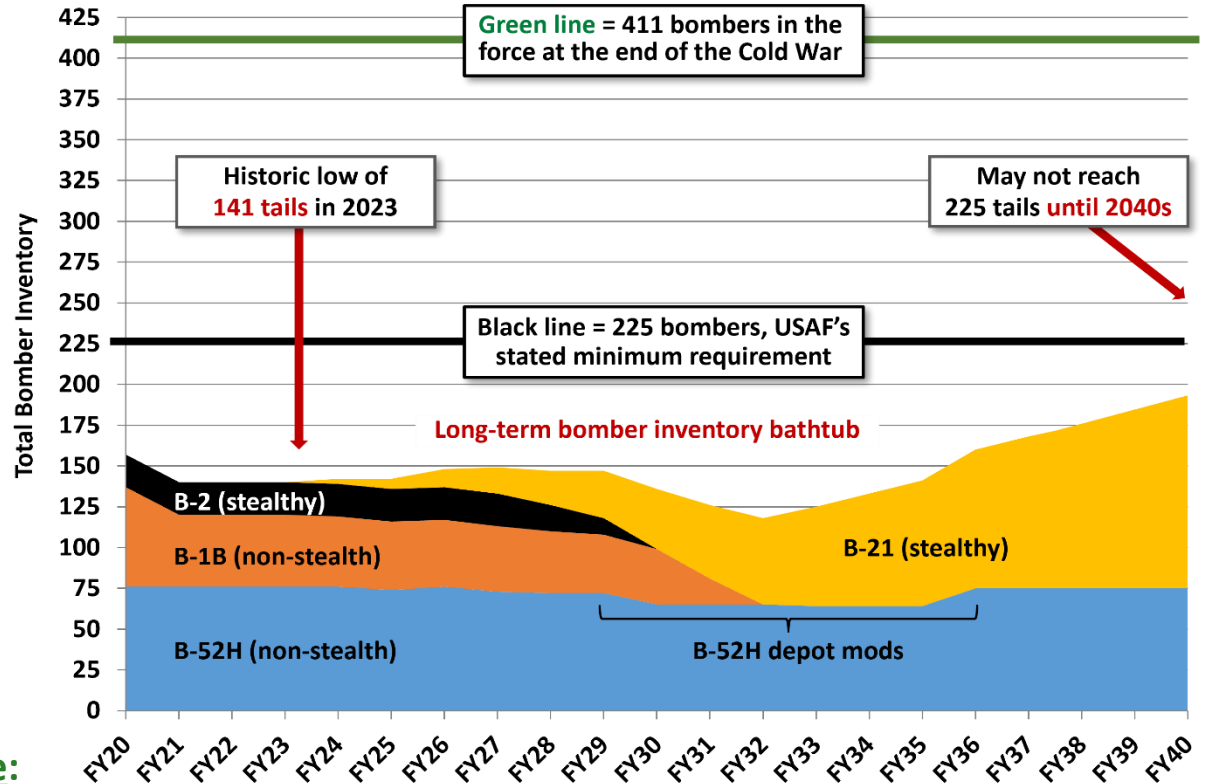
Bomber force size is critical to deterring threats this decade

3 factors that can increase duration of bomber shortfall:

- Insufficient Air Force budget to maintain all B-1s and B-2s in the force as B-21s are delivered
- Insufficient crew & maintainers to transition to B-21s plus sustain B-1 and B-2 forces
- B-52s undergoing major mods at depot (reengining, etc.) unavailable for operations

3 actions that can reduce bathtub and enhance deterrence this decade:

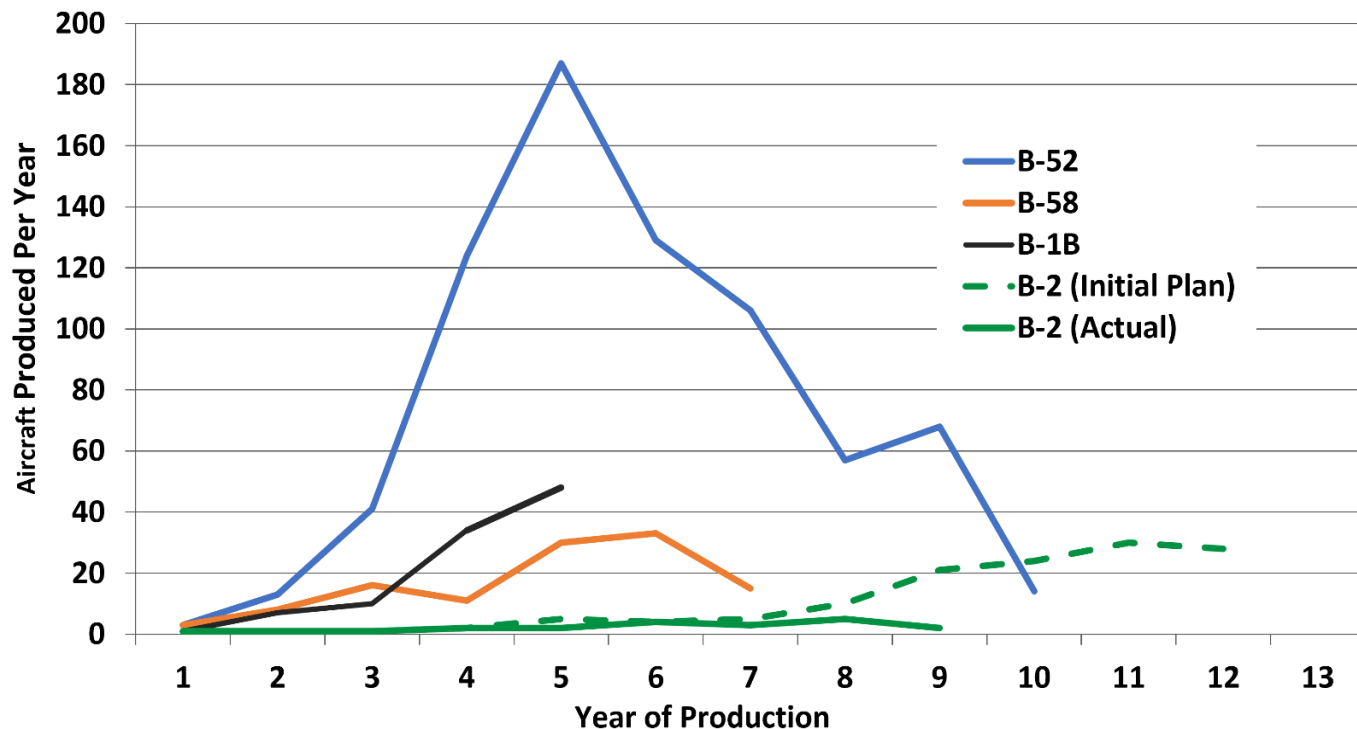
- Keep all current bombers in the inventory until the B-21 force reaches full operational capability (FOC), penetrating strike is the most significant shortfall, so must extend B-2 well into 2030s
- Increase USAF budget topline and end strength to support a larger bomber force and B-21 transition
- Maximize B-21 acquisition rate





B-21 acquisition rate is an opportunity to enhance deterrence

- **Production of each of the Air Force's last 4 bombers completed in 10 years or less**
 - The Air Force planned to ramp B-2 production to an average of 22 per year for a 132 aircraft inventory
- **At theoretical rate of 8-9 B-21s per year, acquiring 145 could take until 2040s (including ramp time)**



Senior DOD official on the FY24 budget: “more money cannot buy-back lost time”

True...but more resources can buy-back future risk

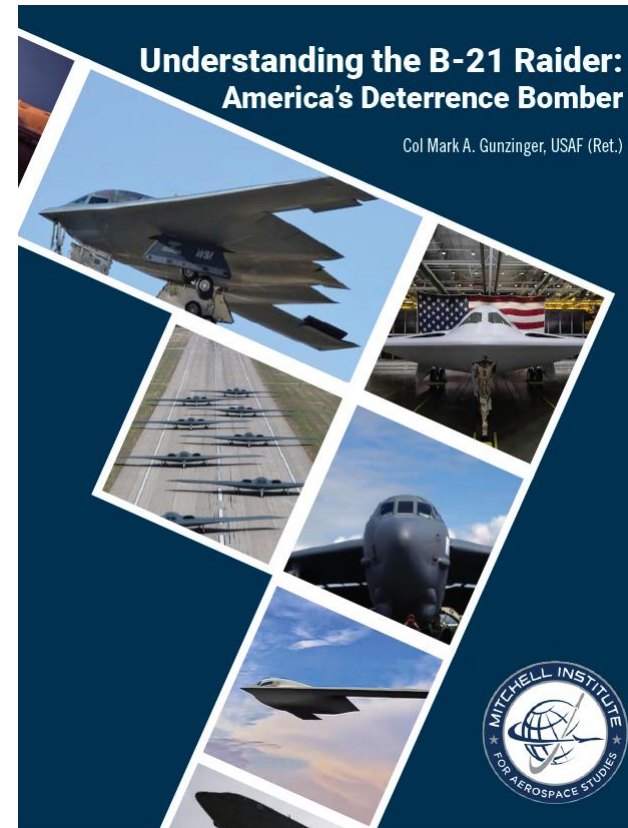
Buying B-21s at a rate of 20 per year or more would enhance deterrence this decade, not in some distant future

The B-21 is “visual proof that our nation’s technical prowess remains unrivaled and that we can accelerate change and mindfully prepare to deter, meet, and blunt threats now and in the future.”

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



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