THE ARSENAL OF DEMOCRACY

TECHNOLOGY, INDUSTRY, AND DETERRENCE IN AN AGE OF HARD CHOICES

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LONG-RANGE STRIKE

In recent decades, China has rapidly caught up with the United States in its ability to strike targets at great distances with relatively small but lethal payloads. China has invested heavily in stockpiling missiles and expanding its production capacity. Meanwhile, the US defense industrial base has fallen behind in the production of long-range munitions.[1] Naval history suggests that such an asymmetry is likely to cause serious problems for US forces, especially in a prolonged conflict. In a war's early days, China's long-range missiles may force US assets, including land-based fighter aircraft, to remain at a significant distance from the First Island Chain. Worse, China's missile stockpiles are larger and its production lines more robust. If a war drags on for weeks or months—or if China, defeated at first, tries to reconstitute and attack again—US forces could find themselves in a difficult position.

This chapter describes how the United States can keep pace by maintaining the ability to deliver large volumes of long-range strikes from longer ranges. It focuses on airpower, cruise missiles (which fly at a low altitude toward their target), and ballistic missiles (which follow a parabolic arc). It is concerned with both traditional missiles and hypersonics—their more modern, significantly faster successors.

Since keeping pace in long-range strikes is critical for deterrence, the DOD urgently needs to scale up its stockpiles of long-range precision munitions and persuade its suppliers and their subcontractors to ramp up production capacity. This effort must prioritize both traditional and hypersonic cruise and ballistic missiles, as well as cruise missiles such as the Joint Air-to-Surface Standoff Missile (JASSM) and its cousin the Long-Range Anti-Ship Missile (LRASM), new anti-ship missiles like the Naval Strike Missile (NSM), and the traditional workhorses, the Harpoon and Tomahawk. These weapons systems will be deployed across multiple platforms—submarines, surface ships, aircraft, and mobile land-based launchers in the First Island Chain.

The Historical Value of Long-Range Strike

In recent decades, effective communications, longer-range surveillance, and more accurate munitions have created a battlefield environment where combatants can inflict severe damage from great distances with a relatively small number of extremely accurate munitions. Military analysts call this the "precision strike regime." This concept is fundamental to US and PRC planning for a potential war in the Pacific, as long-range weapons systems integrate with modern sensors to create a networked military in which sensors direct shooters to their targets.

In World War II, long-range strikes were delivered by aircraft, both land based and carrier based.[2] Ships in the 1940s carried short-range anti-aircraft weapons, but until late 1943 they were no match for massed attacks from the air. Surface ships, including aircraft carriers, struggled to defend themselves from land-based aircraft. Carrier fighters had shorter ranges and therefore could not be massed as effectively. From 1940 to 1943, the Axis controlled the central Mediterranean, the Allies the east and west. In modern parlance, each enjoyed "anti-access area denial" capabilities in the sectors it controlled. In the Mediterranean campaign that started in June 1940, warships that ventured into the enemy's defensive bubble were typically spotted and attacked within hours.[3] The campaign began when the Italian army invaded Libya. The Axis and the Allies used surface warships, submarines, and land-based aircraft, and the Allies—for the first time—used aircraft carriers. The hardest fighting was over Crete and Malta, which bracketed the eastern Mediterranean.[4] Whichever power controlled these islands could use them to forward-deploy land-based strike aircraft and fighters, squeezing the other's area denial bubble. Absent air cover, penetrating enemy air denial networks was near suicidal for exposed surface ships. Hence, traditional fleets restricted their operations to the edges of the enemy denial bubble, penetrating it only for brief periods of time and only with well-coordinated air cover.[5]

Navies that failed to grasp the threat posed by enemy airpower were annihilated. At the Battle of Cape Matapan off southwestern Greece in March 1941, a squadron of Italian warships strayed into the Allied area denial network. British torpedo bombers based on the HMS *Formidable*, supported by additional British bombers in Crete, together sank five Italian ships and damaged two more while the British fleet suffered almost no harm. After the Germans conquered Greece and extended their air cover east, the situation was reversed. In the Battle of Crete in May 1941, the Allies lost a dozen warships operating within a new Axis area denial network.[6] The Allies broke the Axis area denial network only through the amphibious invasion of Italy in 1943, which disrupted Axis supply lines in the Mediterranean.

Today, most precision missiles have a range of hundreds of kilometers, can hit targets within several meters of accuracy, and travel quickly, complicating interception.[7] Today, as in the 1940s, whichever side can base its long-range strike at least partly on land enjoys an advantage. Moreover, when long-range strike is used to degrade the enemy's reconnaissance capabilities, it makes it possible for air and sea assets to engage from closer ranges, which can bring compounding returns.

Long-range strike can also put forward-deployed air assets at risk, particularly if air bases lack effective air defenses. Before hostilities broke out with Japan in December 1941, the US Far East Air Force was actively ramping up forces at six airfields in Luzon, the Philippines' northern island. However, located just a few hundred kilometers from Japanese-controlled Formosa (modern Taiwan), these airfields were within easy reach of Japanese land-based bombers and fighters. Japan's surprise air strikes on the Philippines in the early morning hours of December 8, 1941, caught US aircraft unprepared. Of the seventeen B-17 bombers on the ground at Clark Field, twelve were destroyed, four were damaged, and only one escaped unscathed. Thirty-four P-40 fighters were also destroyed, either on the ground or in aerial combat. What remained of the fighting force had to be evacuated to Australia.[8]

Airpower

Today, the United States has formidable land-based airpower stationed within range of Taiwan—but these air bases are potentially as vulnerable to China's missiles as the US Army Air Forces in Asia were to Japan's air strikes in 1941. Kadena Air Base on Okinawa has been described as "uniquely ill-positioned for permanently basing large numbers of American aircraft" owing to its proximity to China's coast.[9] According to one analysis, the PLA could fire 252 missiles at Kadena in a single salvo and 26 at Misawa Air Base in northern Japan.[10] Even Andersen Air Force Base on Guam, the logistical linchpin for US airpower in the region, is within range of China's DF-26 missiles.[11]

Recognizing this reality, the United States has already withdrawn two F-15C and D fighter squadrons from Okinawa. Unfortunately, basing aircraft farther away also makes them less relevant. The F-16 are very high quality aircraft, but with a combat radius of less than 600 kilometers they cannot influence the aerial balance around Taiwan from Guam, which is 2,700 kilometers away. Bombers have longer ranges, but they are expensive and high-value assets. In the Air

Force, fighter squadrons outnumber bomber squadrons some eight to one.[12]

The Air Force cannot quickly engineer a new generation of fighter jets with much longer ranges, but it can house them in hardened shelters and disperse them geographically to make the force more resilient. As mentioned, the Air Force has developed a new operational concept to describe its efforts in this area: Agile Combat Employment (ACE). Rather than relying on large, fixed installations, ACE emphasizes resilience and flexibility of operations, rapid deployment, and dispersal of forces across a network of smaller, more agile bases.[13] It also involves classified counter-scouting techniques.

As China's long-range strike capabilities are putting US forward-deployed fighters at risk, the Air Force's bomber fleet is becoming an increasingly important tool for preserving deterrence.[14] The US Air Force's bomber fleet comprises 141 aircraft. Each can carry large payloads and operate globally with the aid of aerial refueling. Positioned beyond the PLA's reach—including on US soil—bombers can refuel out of interception range and are capable of striking the PLA Navy in the Taiwan Strait or at China's ports with long-range missiles and then returning to secure bases to prepare for future missions. All US bombers can carry sixteen to twenty-four long-range precision-guided weapons. Ranges on these missiles vary from around 500 to 1,000 kilometers, as we will explore in more detail below. Boeing also produces kits that can transform simple Joint Direct Attack Munition (JDAM) bombs into guided "Powered JDAMs" (PJDAMs) with a range of more than 500 kilometers and decoy PJDAMs with ranges of more than 1,000 kilometers.[15]

If about one-third of the US bomber force were deployed daily, it could deliver around eight hundred missiles against the PLA assault forces each day.[16] China could in principle target and shoot down these bombers and refuelers, but this is not easy. Many of the current bombers are equipped with advanced stealth technologies, and the future B-21 Raider will have even more advanced stealth technology. Moreover, the longer the range of the air-launched missiles that the bombers carry, the farther back from China's RSC they can operate. This discussion illustrates how important it is for the United States to be able to produce ultra high precision, long-range munitions at scale.

Missiles in the Indo-Pacific

China's extensive missile arsenal, both land based and air launched, creates a high-risk zone extending roughly 600 to 1,000 kilometers off its coast.[17] Within this zone, American ships (and to a lesser extent aircraft) face significant threats.

China has built a sophisticated missile force built on a strategy of anti-access/area denial (A2/AD). To that end, the PLA Rocket Force (PLARF) maintains more than 3,500 conventionally armed ballistic and cruise missiles centered on the Dong Feng (DF) ballistic missile family.[18] This missile force is strategically structured in multiple tiers. Short- and medium-range ballistic missiles, which make up well over half the arsenal and can reach targets of up to 3,000 kilometers, are primarily positioned to counter Taiwan and US forces in the region.[19] The DF-15 and DF-11 short-range missiles, with ranges under 1,000 kilometers, are concentrated along China's eastern coast for potential Taiwan contingencies.[20] China has also developed several notable anti-ship missiles designed to deny the US Navy access to regional waters. These include the DF-21D "carrier killer," the DF-26D, and the YJ-18 anti-ship cruise missile (ASCM), which is specifically engineered to overcome the Aegis Combat System air defenses aboard US Navy combat ships.[21] Together, these shorter-range forces form a comprehensive deterrent that strengthens China's A2/AD strategy in the Taiwan region.

The United States, by contrast, has limited stockpiles of cruise missiles capable of striking beyond 600 kilometers. The asymmetry in missile numbers, alongside the potential escalatory risks of hitting missiles on the Chinese mainland, creates a dynamic where PLA naval and air forces are relatively protected near their coastline, even though they would become increasingly vulnerable as they ventured into the Philippine Sea, where they could lose both sensor coverage and air support from their land-based fighters.[22] China appears to be planning for this challenge by developing capabilities for an eventual breakout into the Philippine Sea, east of Taiwan, after wearing down US and allied missile defenses. This strategy explains China's investment in large missile-armed surface ships, strike aircraft, aerial refueling tankers, aircraft carriers, and land-based unmanned aircraft with good sensors.[23]

Taiwan possesses some counterweight to this missile threat but needs to develop it further. Taiwan's arsenal includes the 600-kilometer range Hsiung Feng IIE cruise missile and the 1,200-kilometer range Yun Feng cruise missile.[24] Most of Taiwan's land-attack missiles are road mobile, which makes them more survivable. However, Taiwan faces significant geographic constraints. Because the island is just 36,000 square kilometers, if China can achieve command of the air over Taiwan, it can use vast numbers of relatively unsophisticated MALE UAS to blanket the island. If PLA forces could establish a beachhead or airhead, they could also deploy swarms of small, disposable drones for reconnaissance and strike missions against Taiwan's forces. It is therefore essential that Taiwan plan to hide its counterstrike capabilities and fire from within "clutter"—the echoes or other misleading signals in radar, satellite, and other sensor data that can compromise target detection and identification. Taiwan's mountainous terrain, complex urban environments, and dense cloudy weather provide natural sources of protective masking clutter.[25]

Taiwan also faces challenges in producing and acquiring necessary munitions in quantity. Although Taiwan's missiles could complicate PLA operations in a short war, without US resupply of missiles or components, Taiwan's arsenal would face rapid depletion. The United States could theoretically transfer long-range missiles to Taiwan in advance of a potential conflict, but China would regard such an action as a violation of the Three Communiqués, which it calls "the political foundation of the US-China relationship," and might respond by moving violently against Taiwan.[26] Transferring these weapons during a crisis would be logistically challenging, particularly if China imposed a blockade.

Although regional allies might seem like an alternative source of support, they face their own limitations. Japan, for instance, has recently begun to develop offensive missile capabilities, committing to creating a land-attack cruise missile program in its 2023 Defense White Paper and funding procurement of land-attack missiles in its 2023–24 defense budget.[27] However, Japan's defense industrial base, though high quality, is small. Missile production in Japan is set to expand gradually over the next five years.[28] In the Philippines, the main barrier has been the domestic politics of basing. The Philippine Senate voted in 1991 to expel US forces from the key bases at Clark and Subic Bay.[29] Since 2014, there have been incremental agreements to bring the United States back into key facilities, including in the critically located northern island of Luzon. However, progress has been incremental, and these facilities remain underdeveloped.[30] An important milestone came in 2024, when the United States deployed its Mid-Range Capability, also known as the Typhon transporter-erector-launcher system, to Luzon. Manila subsequently announced that it would be acquiring the system, which is capable of launching Tomahawk and Standard Missile-6 missiles. However, progress will likely be slow. The Philippines takes at least two years to go from planning to acquisition of new missile systems; it took five years to acquire BrahMos missiles from India, for example.[31]

American long-range strike assets are therefore essential to the defense of Taiwan, particularly in the short to medium term. US submarines will be crucial to breaking China's anti-access network, as subsequent chapters will discuss in detail. However, US submarines can strike only so many Chinese targets without giving away their location and putting themselves at risk. Thus, US surface ships and aircraft will need huge quantities of long-range precision munitions to address a potential Chinese invasion of Taiwan from many hundreds of kilometers away. The United States and China are competing over three categories of missile-related systems: hypersonics, non-hypersonic missiles, and air and missile defense. Washington must invest heavily in all three.

A Typology of Missiles

Missiles can be divided into two categories based on their flight trajectory: ballistic missiles and cruise missiles.[32]

Ballistic missiles follow a parabolic trajectory, arcing toward their targets. First developed during World War II by Nazi Germany under the V-weapon program, ballistic missiles—particularly intercontinental ballistic missiles (ICBMs), which exit the atmosphere during their flight—remain a cornerstone of modern nuclear arsenals.[33] Ballistic missiles can carry multiple warheads—both conventional and nuclear—and are highly effective against fixed targets due to their speed and predictable trajectory. Traditional ballistic missiles struggle to engage moving targets, but advancements like maneuverable reentry vehicles (MaRVs) have introduced some capability for in-flight adjustments.[34]

Cruise missiles, by contrast, fly on flatter, powered trajectories and are typically equipped with small wings for aerodynamic stability. They were historically described as “flying bombs” and use either air-breathing engines or rocket propulsion.[35] Unlike ballistic missiles, cruise missiles maintain propulsion throughout their flight, making them well suited for targeting mobile platforms like warships. Their continuous propulsion and integrated guidance systems allow real-time course corrections, increasing their effectiveness against moving targets.

A major development in missile technology is the proliferation of hypersonic weapons, which amplify cruise and ballistic missile capabilities. Hypersonic weapons travel at speeds exceeding Mach 5 (about 6,100 kilometers per hour), significantly reducing the reaction time available for defenses.[36] Technically, all ballistic missiles are hypersonic during portions of their flight, but today’s hypersonic weapons are unique in their ability to maneuver at extreme speeds. The United

States, Russia, and China are all developing conventionally armed hypersonic systems that can engage moving targets. As hypersonic technology evolves, it could become extremely important for deterrence.

Modern hypersonic weapons fall into two main categories. Hypersonic cruise missiles (HCMs) use advanced air-breathing engines, such as scramjets, to sustain high speeds over long distances.[37] They combine this speed with a cruise missile's capability to follow a nonlinear trajectory, enabling them to evade defenses and approach targets from unexpected angles. Hypersonic glide vehicles (HGVs),[38] by contrast, are launched via ballistic missiles and separate from their boosters mid-flight.[39] Unlike traditional ballistic missile warheads, HGVs can glide at high speeds and maneuver during descent, allowing them to adjust their trajectory and potentially track moving targets. This makes them far harder to intercept.

Scaling up production of hypersonic weapons is expensive and technically difficult. Designing systems that can withstand the extreme heat generated by hypersonic speeds requires specialized materials and advanced engineering. Propulsion systems, particularly scramjets, are complex and expensive to produce, leading to long developmental timelines and limited production capacity. For the near future, commanders will need to reserve hypersonic weapons for high-value targets, carefully weighing their operational use. Whether air-, ground-, sea-, or submarine-launched systems will prove most effective remains uncertain, but the addition of HCMs and HGVs to arsenals significantly complicates air and missile defense.

Several nations are working to overcome these technical and production challenges, and China has made particularly significant advances in this domain. According to the DOD, China now has the "world's leading hypersonic missile arsenal," with advanced conventional and nuclear-armed systems.[40] At the core of China's capabilities are the DF-17 medium-range ballistic missile (MRBM), equipped with a hypersonic glide vehicle (HGV), and the formidable DF-27 ICBM, which is believed to combine HGV technology with conventional and nuclear payload options.[41] These longer-range systems possess sufficient reach to strike targets as distant as Alaska and Hawaii.[42] China demonstrated its technical sophistication in 2021 by testing an ICBM-range HGV that traveled 40,000 kilometers around the earth using a fractional orbital bombardment (FOB) system—technology that could be used to evade US missile defenses.[43] Further expanding its capabilities, the PLA added the YJ-21 hypersonic anti-ship ballistic missile (ASBM) to its arsenal in 2022.[44]

The US Missile Arsenal Today

In response to these developments and other strategic considerations, the United States has been working to advance its own missile capabilities. The current US missile arsenal includes a number of non-hypersonic cruise missiles, along with several hypersonic weapons under development. It needs to accelerate the deployment speed of the former. It also needs to increase procurement of the latter, namely the JASSM/LRASM Line, Tomahawk, and Harpoon (see table 3.1).

The Army's Long-Range Hypersonic Weapon (LRHW), a Lockheed Martin ground-launched boost-glide vehicle, is set to become the first US hypersonic to enter service.[45] The Navy will procure a ship-and-submarine-launched version of LRHW, set for initial limited deployment in 2025, with longer-term production increases likely in the 2030s.[46] The Navy has also contracted Lockheed Martin and Raytheon (now RTX) to develop the Hypersonic Air-Launched Offensive anti-ship weapon (HALO), which is scheduled for deployment in the late 2020s.[47] It is not clear from open sources whether US air-launched hypersonic missiles currently face technical hurdles. The Lockheed Martin-Raytheon Air-launched Rapid Response Weapon (ARRW), an air-launched ballistic missile with a 1,600-kilometer range, was canceled after multiple test failures.[48] ARRW's failure raises questions about whether other US air-launched hypersonic ballistic missiles have fundamental design problems. Alternatively, the project's failure may have more to do with institutional politics, in which case the program may be reactivated in the future.

Table 3.1 Overview of major missile types in the US arsenal (various)

Missile system	Type	Range	Speed	Unit cost	Number in stock	Description
JASSM	Air-launched cruise missile	370 km (standard), 925 km (extended)	Subsonic	$1.5 million	Est. 3,000	Stealth elements, accuracy to 3 meters over 50% of the time
LRASM	Air-launched anti-ship missile	370 km	Subsonic	$3 million	Est. 350	More stealth components than JASSM
Tomahawk Block V	Cruise missile	1,600 km	Subsonic	Est. $1.89 million	N/A	Land attack and anti-ship variants
Harpoon	Anti-ship missile	250 km	Subsonic	Over $2 million	N/A	Widely used by foreign militaries
SLAM-ER	Cruise missile	250 km	High subsonic	Est. $500,000	N/A	Extremely accurate
Naval Strike Missile (NSM)	Anti-ship missile	185 km	High subsonic	Est. $2 million	N/A	Planned for marine use
Standard Missile 2	Multi-purpose	75–350 km	Mach 3.5	Est. $2 million	N/A	Multiple variants, dual-purpose anti-air and anti-ship missile

Table 3.1 (continued)

Missile system	Type	Range	Speed	Unit cost	Number in stock	Description
Standard Missile 6	Multi-purpose	240–500 km	Mach 3.5	Est. $4 million	N/A	Multiple variants including long-range air-to-air missile
Hyper-sonic Glide Vehicle (HGV)	Ballistic missile	2,500 km	Higher than Mach 5	Est. $41 million (avg. for 300)	N/A	Maneuver-able, hard to intercept
Hyper-sonic cruise missile (HCM)	Cruise missile	Shorter than HGV	Higher than Mach 5	N/A	N/A	Uses scram-jet engine

Note: Standard Missile 2 and Standard Missile 6 specifications vary with missile variant and mission type.

Although the United States, along with China and Russia, are world leaders in hypersonic weapons development and deployment, US allies are also investing in the technology. Australia's Hypersonic Attack Cruise Missile (HACM), a scramjet cruise missile, builds on two predecessor programs, one American, the other joint American and Australian. As of mid-2024, the Australian military was integrating HACM into its fixed-wing fighter fleet.[49] The US Air Force has also begun to fund HACM production.[50] Although the United States and Australia are not publicly conducting joint procurement, this may be possible under AUKUS, the trilateral security partnership between Australia, the United Kingdom, and the United States.[51] Australia is an ideal partner for hypersonic development given the size of its test ranges in the country's extensive deserts.[52] British hypersonic investments also matter. Following on from AUKUS, which has a hypersonic component, the United Kingdom has stood up its own hypersonic research program: the Hypersonic Air Vehicle Experimental (HVX) technological demonstrator.[53] However, the United Kingdom does not have the independent research budget or facilities to develop a hypersonic weapon independently, necessitating collaboration with partners.[54] Japan and South Korea have also begun developing their own hypersonic weapons. South Korea's Hycore cruise missile is meant to enter service later this decade.[55] However, it is unclear how far the program has progressed since testing began in 2022.[56] Japan has two programs, the Hyper Velocity Guided Projectile (HVGP) and the Hypersonic Cruise Missile (HCM).[57] The former is more advanced than the latter, having been tested in summer 2024.[58]

Despite the relevance of hypersonics, conventional weapons will remain the backbone of US missile arsenals, given their cost and complexity. Lockheed Martin's JASSM/LRASM line is a versatile family of precision-guided weapons. The JASSM, an air-launched cruise missile with some stealth elements, has a range of 370 kilometers and achieves a targeting precision of within three meters over half the time.[59] Its extended range variant (JASSM-ER) extends this capability to 925 kilometers. The LRASM is an air-launched anti-ship missile with more stealth components.[60]

Although the JASSM is primarily deployed by the Air Force and the LRASM by the Navy, both systems are multiservice capable. The JASSM is Navy compatible, and the Air Force's B-1 bombers can deploy the LRASM. To further expand their versatility, Lockheed Martin is developing a LRASM variant that can be fired from a High Mobility Artillery Rocket System (HIMARS) launch system.[61] Ukrainian forces have used HIMARS to great effect in Ukraine, and Lockheed Martin can produce HIMARS in reasonably large numbers.[62] The MGM-140 Army Tactical Missile System (ATACMS) might also be relevant. In a conflict, US Marine Corps units operating stealthily out of the Ryukyu archipelago might also want to use HIMARS and LRASMs together. The Marine Corps has probably developed innovative methods to conceal these sorts of systems from detection by PLA scouts.[63] The United States has delivered both HIMARS and ATACMS to Taiwan.[64]

Stealth cruise missiles like the LRASM and the JASSM provide unique bridge capabilities between traditional cruise missiles and hypersonics in their mission capabilities. They are not nearly as fast as hypersonics, but they are capable of penetrating sophisticated air defenses. Ukraine's employment of the British Storm Shadow/SCALP-EG cruise missile against Russian forces is illustrative.[65] Low-observability cruise missiles like the JASSM/LRASM are a crucial part of the United States' broader missile arsenal.[66]

It would be beneficial for the DOD to procure both types of missiles in large numbers. Today, the United States likely has around 3,000 JASSMs and around 350 LRASMs in its stockpile. The small number of LRASMs is due to the fact that these missiles were first deployed in 2018. Public-domain wargames suggest that in a war over Taiwan, US forces could run down this stockpile in as little as two weeks.[67] At the beginning of the Iraq War, in 2003, US forces used 800 cruise missiles in just a few weeks.

The challenge is in ramping up production capacity. Lockheed has committed to expanding LRASM production from around 30 missiles per year to 120 in 2024.[68] But continuing such a rapid expansion will be extremely difficult and require long-term investments in production facilities. Missiles also have very complex supply chains, so all the key subcontractors similarly need to ensure that they will have sufficient supply if demand ramps up quickly. Congress can deal with this issue by funding purchases of missile components as well as the missiles themselves in future-year block-buys.

Traditional cruise missiles like the Tomahawk are slower and work on older technology than the JASSM and the LRASM, but they are the most prevalent strike weapon in the US arsenal and are easier to produce in quantity. Historically speaking, the United States has procured land attack and anti-ship Tomahawks. Although the Tomahawk's anti-ship variant was withdrawn from service in 1994, it is possible to restart production on newer Tomahawks with guidance-system changes. The Army is showing growing interest in Tomahawk procurement, and the Air Force will probably follow. Each Tomahawk Block V costs around $2 million.[69] Again, working with the subcontractors will be essential to ensure that there are no supply chain disruptions.

Finally, the Harpoon anti-ship missile and its extremely accurate cruise missile cousin, the Standoff Land Attack Missile-Expanded Response (SLAM-ER), remain relevant to the Navy's planning.[70] In 2020, Boeing reopened the SLAM-ER production line to meet foreign contracts, so production lines will already be in motion if the Navy needs to procure more in the future.[71] Harpoons are old, but their common employment in foreign militaries makes the weapon an attractive option for large-scale capacity expansion. The issue is the price point. Absent a major production line expansion, which would probably require a major arms sale to a foreign partner, Harpoons will remain expensive to produce.

The Marine Corps's plan to purchase the Naval Strike Missile (NSM), produced by Norway's Kongsberg Defence and Aerospace (KDA), and deploy it on the Navy Marine Expeditionary Ship Interdiction System, a missile launcher mounted on a remotely controlled truck. US allies, particularly Poland, are extremely interested in large block buys of NSMs.[72] If the marines' rapid transition to littoral warfare and anti-ship capabilities proceeds apace, they may demand more NSMs than Norway can produce, necessitating SLAM-ERs and Harpoons instead. The DOD would benefit by working more closely with the services and foreign military sales to rationalize production lines.

The question of how to scale up missile production among US allies is technocratic, but the stakes could scarcely be more strategic. The war in Ukraine has confirmed that even modern militaries with expensive long-range precision systems still need large numbers of cheaper, less sophisticated missiles. Russia used more than five thousand missiles and loitering munitions in the first fifteen months of war, for example.[73] Even if China's missiles are less accurate than their US counterparts, they on average outrange those of the United States. China's missile forces can already saturate Taiwan and Okinawa and hold facilities in southern Japan, South Korea, and the Philippines at risk.[74] The PLA Rocket Force, which is responsible for China's nuclear missile deterrent as well as conventional ballistic and cruise missile operations, has more than three thousand ballistic and cruise missiles, of which fewer than one thousand can travel farther than 3,000 kilometers.[75] The PLA Air Force and Navy can probably deploy thousands more.[76] That means that the United States might have to build even larger stockpiles to maintain effective parity than the raw numbers imply.

Although most US missiles are designed for a single mission, a few critical munitions serve both air defense and anti-ship roles. Chief among them is the Standard Missile (SM) series, particularly the SM-2 and SM-6. These multi-role weapons are essential for fleet defense and offer secondary strike capabilities, making their production lines a key focus for assessing potential bottlenecks.

Designed in the mid–Cold War, the SM-2 and its variants remain the backbone of US fleet air defense. As a short- and mid-range interceptor, the SM-2 is crucial for protecting surface forces while also providing a secondary surface-to-surface strike capability. Given the Harpoon's shorter range and slower speed, the SM-2 still accounts for a significant portion of the US surface fleet's striking power.

The SM-6, an extended-range evolution of an SM-2 variant, is among the most versatile weapons in the US arsenal, with ship-launched, air-launched, and limited land-based variants. Beyond its fleet air defense role, the SM-6 is capable of ballistic missile defense (BMD) and long-range surface strike. In addition, in 2024 the Navy began to field the AIM-174B, an air-launched SM-6 variant, which is now operational.[77] PRC military analysts have described AIM-174B as a "huge threat" that could "massively change" naval warfare by extending the striking range of US carrier-based aircraft to nearly 900 kilometers, allowing them to potentially target PLA bombers, early-warning aircraft, and air-to-air refueling tankers before they can launch their own attacks.[78] With this weapon, US carrier-based fighters and bombers can now engage PLA aircraft at distances China previously assumed were safe.

The SM-6's ability to integrate with the Aegis Combat System and Cooperative Engagement Capability (CEC) is another key advantage. US ships can engage threats beyond the horizon using sensor data from E-2D Hawkeyes, F-35s, or space-based assets. This sensor-shooter separation makes US surface forces far more lethal, and future upgrades, such as the SM-6 Block IB with a larger 21-inch rocket motor, will further extend its range beyond 370 kilometers and enhance its hypersonic missile interception capability. Its importance will only increase as the US deploys a hypersonic evolution of the SM-6.[79]

Despite their importance, both SM-2 and SM-6 production lines are severely constrained. Raytheon (RTX) is the sole manufacturer. Taiwan's National Chung-Shan Institute of Science and Technology (NCSIST) produces the older SM-1 series, but it cannot support US supply expansion for political reasons.[80] The Pentagon aims to ramp up SM-6 production to three hundred units annually by 2028, a major increase but still far below wartime requirements. Australia and Japan are demanding their own SM-6 supplies, but there are not yet any licensed production alternatives.[81] The US Army is also experimenting with a land-based SM-6 deployment via the Typhon system, which could further increase demand.

Expanding the SM-6 production line must therefore be a top defense priority in the coming budget cycles. At just over $4 million per unit, the missile delivers exceptional operational flexibility at a reasonable cost.

Air Defenses

Given the extent to which PLA's Rocket and Air Forces endanger US assets across the region, it is essential to have abundant and sophisticated air defenses for high-value assets.[82] In addition to its cruise missile arsenal, China is fielding new multiple rocket launchers that can hit targets on Taiwan from the mainland.[83] In a conflict, China might also emulate Russia's approach in Ukraine, building thousands of one-way attack drones, like the Russian-Iranian Shahed, to saturate American and Taiwanese air defenses.[84]

Fortunately, while air defenses struggle with hypersonics, they are quite effective against cruise missiles and drones. Ukraine has shown that with a competent air-defense system, well-trained personnel, and an effective battle management network, it is possible to keep the national power grid from collapsing, despite unrelenting missile assaults.[85] Ukrainian air defense operators are some of the world's best, having integrated Soviet-standard and modern NATO-style air defenses into a comprehensive system around Kyiv that has largely withstood Russian bombardment.[86] In April 2024, Iran attacked Israel with around 170 drones, 30 cruise missiles, and 120 ballistic missiles. Almost all were intercepted by US, Israeli, and other allied air defenses.[87] In October 2024, Iran once again attacked Israel with a barrage of around 200 ballistic missiles, but US, Israeli, and other allied air defenses intercepted most of them.[88]

The United States should work with allies to ramp up production of air defense systems as quickly as possible. The United States needs sufficient supplies of air defenses to protect its own forces, to sell or transfer to allies and partners in the Indo-Pacific and beyond that may need them, and to keep European allies and Ukraine adequately supplied.[89] Patriot air defense systems cost roughly $1 billion per battery. Fortunately, because these systems are defensive in nature, the United States can confidently provide them to Taiwan. This reduces the risk that China will argue the US has crossed its red lines or violated historic agreements with the PRC. Ten Patriot battalions would suffice to cover the entire island of Taiwan and would make it far harder for the PLA to operate attack aircraft over and around the island.[90]

There is thus a strong case for massive, coordinated defense industrial policy, aligned across US allies, to produce and deploy air defense systems at scale. Over the next decade, nearly all US allies and partners in Europe, the Middle East, and the Indo-Pacific will have an obvious and acute need for air defense. US allies also produce high-quality air defense systems, including the more affordable Norwegian-made NASAMs.[91] Allies and partners ought to bear a significant share of the cost because ultimately air defenses are a sound investment in their own national security.

As a stopgap, Washington could lean on NATO allies to sell older air defense systems to Taiwan at reduced costs, as these countries update to newer systems.[92] Washington and NATO allies are already exploring this option for Ukraine, scrambling old Patriot batteries or those used for training.[93] If allies fear PRC retribution, they could transfer these systems to the United States, which could then pass them to Taiwan. If Washington put such a plan into motion now, Taiwan could receive these air defenses by the mid- to late 2020s. Concurrently, while slightly more provocatively, the US could assist Taiwan in developing its domestic missile defense programs, such as the Sky Bow system, by producing parts in the US.[94] Moreover, creating an integrated tracking and fire control system, similar to Northrop Grumman's system, could significantly enhance Taiwan's air defense coverage, range, and effectiveness.[95] Combining these strategies, while prioritizing immediate increases in Patriot sales and cutting red tape to facilitate equipment transfer contracts, would go a long way toward improving Taiwan's defense.

How the US surface fleet must adapt in the face of the threat from China's missiles is a separate and more complex question. Answering it requires a more detailed discussion of changing US operating concepts, counter-scouting technology, point air defense on ships, and the current state of the fleet. We return to this question in chapter 5.

Conclusion

Under the precision strike regime, combatants can inflict substantial damage from great distances with remarkable accuracy. Historical cases, such as the evolution of carrier-based strike aircraft during World War II, highlight the paramount importance of long-range precision weapons in modern air-naval warfare. Just as airpower reshaped naval engagements in the Mediterranean campaign, today's precision munitions necessitate a reevaluation of US naval and air strategies. Air-launched missiles will be increasingly important, given the risks that China's long-range strike capabilities pose to the US surface fleet.

To counter these threats and preserve effective deterrence, the United States must urgently lead an allied effort to scale up and deploy vast numbers of long-range munitions and air defense systems. This is more an industrial and procurement challenge than a technological one, which is why intensive collaboration with allies will be essential. Production lines and supply chains for hypersonic weapons, the JASSM, the LRASM, and traditional platforms like the Harpoon and the Tomahawk must be ramped up as fast as possible. For these missiles, and perhaps others too, it is appropriate to shift to multiyear funding for procurement to incentivize producers of critical subcomponents such as turbofan engines and guidance systems to ramp up capacity. The United States should also accelerate efforts to deploy integrated air and missile defense systems on surface ships and increase R&D spending on emerging air defense technologies.

Although traditional cruise missiles will remain critical for deterrence, hypersonic missiles will become increasingly relevant as production volumes scale up in both allied and adversary countries. Given the potential strategic value of economies of scale in hypersonic missile production, it would be ideal for the DOD to develop a standardized hypersonic platform usable across all service branches, with specifications that would make it easy to sell to allied countries as well. This approach would also support a more reliable supply chain for critical components like scramjet engines. Hypersonics are also fundamental to the AUKUS pact, which Washington must reprioritize. Some technical setbacks and cost overruns are inevitable in the short term, but hypersonic technology will likely be strategically transformative and cannot be ignored.