



An Analysis of the Navy's Fiscal Year 2024 Shipbuilding Plan



At a Glance

Each year, as directed by the Congress, the Department of Defense submits a report with the President's budget describing the Navy's planned inventory, purchases, deliveries, and retirements of ships in its fleet for the next 30 years. Like the Navy's shipbuilding plan for fiscal year 2023, its 2024 plan provides three alternative long-range projections of its future fleet rather than one. In this report, the Congressional Budget Office analyzes the alternatives in the 2024 plan and estimates the costs of implementing each of them. Overall, the objectives of the three alternatives in the 2024 plan are similar to those in the 2023 plan, but the costs have increased substantially, largely reflecting higher estimated costs for submarines.

- **Cost.** The three alternatives in the Navy's 2024 plan would require average annual shipbuilding appropriations that were 31 percent to 40 percent more than the average over the past five years. CBO estimates that total shipbuilding costs would average about \$34 billion to \$36 billion (in 2023 dollars) over the next 30 years, which is about 16 percent more than the Navy estimates. Compared with its estimates for the 2023 plan, CBO's estimates increased by between 5 percent and 10 percent in real (inflation-adjusted) terms, depending on the alternative. To support the 2024 plan, the Navy's total budget would increase from \$245 billion today to between \$315 billion and \$330 billion (in 2023 dollars) in 2053.
- **Purchasing Plan.** The Navy would purchase 290 battle force ships under Alternative 1, 299 under Alternative 2, and 340 under Alternative 3. (Battle force ships include aircraft carriers, submarines, surface combatants, amphibious ships, combat logistics ships, and some support ships.) Overall, Alternative 1 places slightly more emphasis on buying large surface combatants than Alternative 2 does. Under Alternative 2, the Navy would buy more submarines than under the other alternatives, although it would purchase more existing classes of submarines and fewer next-generation submarines. Under Alternative 3, the Navy would buy more ships of all types, except for submarines, than under the other alternatives. (The 2024 plan offers few details about the costs or quantities of unmanned surface or undersea vessels.)
- **Fleet Size.** If the Navy adhered to the schedule for purchases and ship retirements outlined in its 2024 plan, by 2053 the number of battle force ships would increase from 290 today to 319 under Alternative 1, 328 under Alternative 2, and 367 under Alternative 3. In all three cases, the fleet would be smaller over the next 10 years than it is today, before increasing in size.
- **Fleet Capabilities.** Under all three alternatives, the Navy would reduce the fleet's firepower over the next decade but would eventually expand its missile capability by increasing the number of missile cells (which are vertical tubes or launchers on surface ships and submarines that carry the Navy's offensive and defensive missiles) and deploying them on more ships than they are deployed on today.

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Notes

Unless this report indicates otherwise, all years referred to are federal fiscal years, which run from October 1 to September 30 and are designated by the calendar year in which they end.

In this report, “cost” refers to budget authority, the amount that would need to be appropriated to implement the Administration’s plans; all dollar amounts reflect budget authority in 2023 dollars.

Numbers in the text, tables, and figures may not add up to totals because of rounding.

Previous editions of this report are available at <https://tinyurl.com/mr24mftf>.

On the cover:

Top left: The Arleigh Burke class guided missile destroyer USS *Momsen* (DDG-92). U.S. Navy photo by Mass Communication Specialist 2nd Class James R. Evans.

Top middle: The aircraft carrier USS *Nimitz* (CVN-68; the lead ship in its class). U.S. Navy photo by Mass Communication Specialist 3rd Class Siobhana R. McEwen.

Top right: The Lewis and Clark class dry cargo ship USNS *Sacagawea*. U.S. Navy photo.

Bottom left: The amphibious transport dock ship USS *San Antonio* (LPD-17; the lead ship in its class). U.S. Navy photo by Mass Communication Specialist 3rd Class Lacordrick Wilson.

Bottom right: The Virginia class attack submarine Pre-Commissioning Unit *Mississippi* (SSN-782). U.S. Navy photo courtesy of General Dynamics Electric Boat.

An Analysis of the Navy's 2024 Shipbuilding Plan

Summary

The Department of Defense (DoD) submitted the Navy's shipbuilding plan for fiscal year 2024 to the Congress on March 30, 2023.¹ The Congressional Budget Office is required by law to analyze that plan and assess its costs.

Like the 2023 shipbuilding plan, the Navy's 2024 plan comprises three alternative programs instead of one: Alternatives 1 and 2 reflect trade-offs between different types of ships requiring similar amounts of spending, according to the Navy's estimates. Alternative 3 outlines the additional capability the Navy could achieve with more spending (see Table 1). CBO analyzed the three alternatives. Underlying all of them is an effort to eventually arrive at a fleet whose firepower is greater and distributed among more ships than in today's fleet.

The average annual cost of carrying out the Navy's three alternative plans, which cover fiscal years 2024 to 2053, ranges from \$33.6 billion to \$36.1 billion (in 2023 dollars), CBO estimates. (Those estimates include the costs of purchasing ships but not the costs of operating and maintaining them.) The Navy's 2024 plan is similar to its 2023 plan with respect to the types and numbers of ships that it would purchase under the three alternatives.² However, CBO found that the costs of the 2024 plan are substantially higher than those in the 2023 plan (after adjusting for inflation), largely because of higher unit costs for major shipbuilding programs, especially submarines.

The 2024 shipbuilding plan (like the 2023 plan) would move the Navy toward a larger and more distributed fleet comprising more smaller combat ships and fewer

large warships than are in today's fleet. The Navy now has 31 small surface combatants and mine countermeasures ships and 118 large surface combatants and large amphibious ships. (The service currently has no small amphibious ships.) By 2045—a year the Navy uses as an important benchmark for assessing its shipbuilding goals—Alternative 1 would establish a fleet with 38 more small surface combatants and medium landing ships (which are small amphibious ships) than the Navy's current fleet but with 17 fewer large surface combatants and large amphibious ships (see Table 2). Under Alternative 2, there would be 34 more of those smaller ships but 22 fewer of the large ships. And under Alternative 3, there would be 51 more small surface combatants and medium landing ships and 11 fewer large surface combatants and large amphibious ships. If fully implemented, any of the alternatives would eventually result in a fleet that was larger than at any time since 2001.

Neither the 2023 plan nor the current plan includes inventory goals for the major components of the Navy's fleet. On June 20, 2023, the service sent its Battle Force Ship Assessment and Requirement (BFSAR) report to the Congress. According to the Navy, the report aligns its shipbuilding goals with DoD's most recent national security strategy; but the report's details are classified. Media reports indicate that the Navy has set a goal of 381 battle force ships, including 31 large and midsize amphibious ships.³ In the 2024 plan (as in the 2023 plan), the Navy refers to several studies and analytic research on the future battle force that informed its choices in formulating the plan's three alternatives. In this report, CBO analyzes and compares those three alternatives—not only as they relate to one another but also to significant aspects of the 2023 shipbuilding plan and to the Navy's broad goals of building a larger and more distributed fleet. CBO also compares the alternatives with respect to several measures of naval capability introduced in the 2023 plan and repeated in the current one.

1. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2024* (March 2023), <https://tinyurl.com/37bkemd9> (PDF).
2. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2023* (April 2022), p. 6, <https://go.usa.gov/xJtjj> (PDF). See also Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2023 Shipbuilding Plan* (November 2022), www.cbo.gov/publication/58447.

3. Sam LaGrone, "Navy Raises Battle Force Goal to 381 Ships in Classified Report to Congress," *USNI News*, (July 18, 2023), <https://tinyurl.com/334esnms>.

Table 1.

Emphasis and Cost of the Alternatives in the Navy’s 2024 Plan, as Assessed by CBO

	Alternative 1	Alternative 2	Alternative 3
Emphasis	The Navy would buy more large surface combatants and fewer attack submarines than under Alternative 2 but would buy more next-generation variants of those ships. It would buy the fewest large amphibious ships but would build small amphibious ships faster than under Alternative 2.	The Navy would place the most emphasis on undersea warfare by buying more submarines than under the other alternatives. It would buy fewer next-generation submarines and more submarines of existing classes. It would buy more large amphibious ships than under Alternative 1 and fewer small ships than under Alternatives 1 or 3.	The Navy would buy more of all types of ships (and many more support ships), except for submarines, than under the other alternatives. Like Alternative 1, this alternative emphasizes moving to the next generation of major combatants.
Features common to all three alternatives	Under all alternatives, the Navy would seek to maintain a balanced fleet with proportionate mixtures of large and small combatants. A large carrier force would be maintained under each alternative, and the same number of ballistic missile submarines would be purchased.		
Average annual cost of all shipbuilding activities (billions of 2023 dollars)	33.8	33.6	36.1

Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

The Three Alternatives in the 2024 Plan Would Expand the Fleet to Between 319 and 367 Battle Force Ships

On October 1, 2023, the Navy’s fleet numbered 290 battle force ships—aircraft carriers, submarines, surface combatants, amphibious ships, combat logistics ships, and some support ships. (See the appendix for a description of the major types of ships in the Navy’s fleet.) The 2024 plan reflects the Navy’s desire to build a larger and more distributed fleet. To achieve that goal, the Navy would buy 290 to 340 ships over the 2024–2053 period: 237 to 267 combat ships and 53 to 73 combat logistics and support ships (see Table 3). If the Navy adhered to the schedule for retiring ships outlined in the 2024 plan (that schedule is nearly the same for all three alternatives), it would have a fleet of over 300 ships by the early 2030s (see Figure 1 on page 5). By 2053, the fleet would number 319 ships under Alternative 1, 328 under Alternative 2, and 367 under Alternative 3. However, the fleet would become smaller in the near term under all three alternatives. Over the next four years, the Navy would retire 9 more ships than it would commission, causing the fleet to reach a low of 285 ships in 2026 and 2027 before growing again. But even at that nadir, the fleet would number 5 more ships than it would at its lowest point under the 2023 plan.

Although the 2024 plan does not include many details about the size or composition of the unmanned vessels the Navy envisions procuring, the service provided CBO with a notional plan for those purchases. Under Alternative 1, the Navy would purchase large unmanned surface vessels (LUSVs, which would probably be missile platforms operating in conjunction with large manned surface ships) at a rate of 2 per year; under Alternatives 2 and 3, it would purchase them at a rate of 3 per year. Although the Navy would probably purchase other types of systems, such as medium unmanned surface vessels or large undersea unmanned systems, the 2024 plan does not include them. (It also does not include small expendable drones like the ones that have been used in the war in Ukraine.)

The Costs of New-Ship Construction Under the 2024 Plan Would Average \$30.3 Billion to \$32.6 Billion per Year

CBO estimates that buying only the new ships specified in the Navy’s 2024 plan would cost \$910 billion under Alternative 1, \$906 billion under Alternative 2, and \$979 billion under Alternative 3 (or, over 30 years, an average of \$30.3 billion, \$30.2 billion, and \$32.6 billion per year, respectively—all in 2023 dollars). Those amounts are between 5 percent and 10 percent higher than CBO’s estimates for the 2023 plan, after adjusting for inflation. The Navy’s cost estimates are lower than

Table 2.

Difference Between the Number of Ships in Today's Fleet and the Number in 2045 Under the Navy's 2024 Plan

Number of ships

	Fleet composition as of October 1, 2023	Difference from 2023 fleet		
		Alternative 1	Alternative 2	Alternative 3
Combat ships				
Aircraft carriers	11	-1	-1	0 ^a
Ballistic missile submarines	14	-2	-2	-2
Attack, guided missile, and large payload submarines	52	3	9	6
Large surface ships ^b				
Large surface combatants	87	-9	-13	-6
Large and midsize amphibious warfare ships	31	-8	-9	-5
Subtotal, large surface ships	118	-17	-22	-11
Small surface ships				
Small surface combatants and mine countermeasures ships	31	13	15	18
Medium landing ships	0	25	19	33
Subtotal, small surface ships	31	38	34	51
Subtotal, combat ships	226	21	18	44
Combat logistics and support ships				
Combat logistics	30	13	21	20
Support	34	-1	-2	11
Subtotal, combat logistics and support ships	64	12	19	31
Total, battle force ships	290	33	37	75

Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

a. Under Alternative 3, the carrier force would number 10 ships for nearly all years between 2042 and 2053. In 2045, the force would temporarily increase to 11 ships.

b. Excludes aircraft carriers.

CBO's: \$776 billion for Alternative 1, \$792 billion for Alternative 2, and \$842 billion for Alternative 3 (or, over 30 years, an average of \$25.9 billion, \$26.4 billion, and \$28.1 billion per year, respectively). Those amounts are between 7 percent and 10 percent higher than the Navy's estimates for the 2023 plan, after adjusting for inflation.

The Navy's shipbuilding plan reports only the costs of new-ship construction for battle force ships. It does not report the cost of nuclear refueling or other costs, such as those associated with outfitting new ships or purchasing ships that are not considered part of the battle force (for example, used sealift ships), which are nonetheless typically funded from the Navy's shipbuilding account. If those costs were included, the Navy's average annual shipbuilding costs in the 2024 plan would increase by a little more than \$3 billion, CBO estimates. That increase would apply to both the Navy's estimate and CBO's estimate of the cost of new-ship construction.

In general, CBO's estimates of new-ship construction costs are higher than the Navy's because CBO and the Navy made different assumptions about the design and capabilities of some future ships, used different estimating methods, and treated growth in the costs of labor and materials for shipbuilding differently.⁴ Some of the difference in the estimates stems from uncertainty about the design and capabilities of large ships whose construction would begin in 5 or 10 years—in particular, the next-generation destroyer that would start to replace the Navy's Arleigh Burke class destroyers and the next-generation attack submarine to follow the service's Virginia class submarines. The difference between the

4. Specifically, unlike the Navy, CBO incorporated into its estimates the growth in the costs of labor and materials that exceeds inflation in the economy as a whole. For a more detailed discussion, see Congressional Budget Office, *How CBO Estimates the Cost of New Ships* (April 2018), www.cbo.gov/publication/53785.

Table 3.

Comparison of Ship Purchases and Estimated Costs in the Navy's Fiscal Year 2023 and Fiscal Year 2024 Shipbuilding Plans

	2023 plan (2023–2052)			2024 plan (2024–2053)		
	Alternative 1	Alternative 2	Alternative 3	Alternative 1	Alternative 2	Alternative 3
Number of battle force ships purchased over 30 years						
Combat ships						
Aircraft carriers	5	5	7	6	6	7
Ballistic missile submarines	11	11	11	11	11	11
Large payload submarines	4	6	4	4	6	4
Attack submarines						
Virginia class submarines with the Virginia payload module	23	33	27	11	11	11
Virginia class submarines	0	16	0	10	37	12
SSN(X) next-generation attack submarines	31	17	33	33	18	35
Subtotal	54	66	60	54	66	58
Large surface combatants						
DDG-51 Flight III destroyers	16	18	17	18	20	18
DDG(X) next-generation surface combatants	38	29	47	38	30	46
Subtotal	54	47	64	56	50	64
Small surface combatants						
FFG-62 frigates	17	11	17	16	10	16
FFG-62 Flight II frigates	35	44	40	37	46	42
Subtotal	52	55	57	53	56	58
Large and midsize amphibious warfare ships						
LHA-6 amphibious assault ships	5 ^a	5 ^a	4 ^a	6	5	4
LPD-17 Flight II	1	1	1	0	0	0
LPD(X) next-generation amphibious ships	4	7	9	5	7	10
Subtotal	10	13	14	11	12	14
Medium landing ships	40	34	49	42	36	51
Subtotal, combat ships	230	237	266	237	243	267
Combat logistics and support ships	52	57	74	53	56	73
Total	282	294	340	290	299	340
Costs of new-ship construction (billions of 2023 dollars)^b						
Total cost over 30 years						
Navy's estimate	710	718	786	776	792	842
CBO's estimate	825	859	908	910	906	979
Average annual cost						
Navy's estimate	23.7	23.9	26.2	25.9	26.4	28.1
CBO's estimate	27.5	28.6	30.3	30.3	30.2	32.6
Average cost per ship						
Navy's estimate	2.5	2.4	2.3	2.7	2.6	2.5
CBO's estimate	2.9	3.0	2.7	3.1	3.1	2.9
Addendum:						
Average annual costs of all activities typically funded from budget accounts for ship construction						
Navy's estimate	26.8	27.1	29.5	29.1	29.6	31.4
CBO's estimate	30.7	31.9	33.7	33.8	33.6	36.1

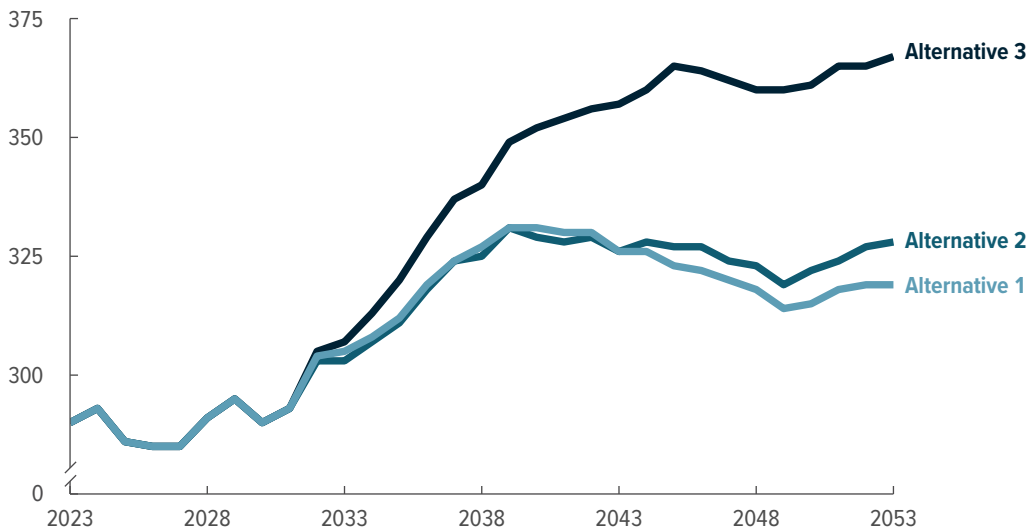
Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

- a. The LHA amphibious assault ship counted in 2023 was authorized by the Congress in 2020. CBO therefore subtracts the 2023 ship from the number of ships the Navy would purchase under all three alternatives.
- b. Costs of new-ship construction include only the costs for purchasing new battle force ships. Thus, they exclude the costs of unmanned systems and ships that are not counted as part of the battle force. Those costs are included elsewhere, as part of all the activities that would be funded in the Navy's shipbuilding accounts. The alternatives in the 2023 plan did not specify the number and type of unmanned platforms that the Navy might buy, so CBO estimated the number of systems the service would purchase.

Figure 1.

Annual Inventories of Battle Force Ships Under the Navy's 2024 Plan

Number of ships



The number of battle force ships would decline over the next 10 years under all three alternatives in the Navy's shipbuilding plan. By 2053, the number of those ships would increase from 290 today to 319 under Alternative 1, 328 under Alternative 2, and 367 under Alternative 3.

Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

estimates also increases over time, in part because the Navy's method of developing constant-dollar estimates (that is, estimates that reflect real costs, which are adjusted to remove the effects of inflation) for most of its shipbuilding programs uses a fixed average real cost per ship; it does not account for the historically faster growth in the costs of labor and materials in the shipbuilding industry than in the economy as a whole. As a result, the Navy's estimates for the future purchases of ships with the capabilities of today's ships do not reflect the same increase in real costs that CBO's estimates reflect.

The growth reflected in the Navy's and CBO's estimates for the 2024 plan is mainly attributable to an increase in the estimated costs of many shipbuilding programs—especially submarine programs—and not to an increase in the number of ships. Those estimated costs have risen for several reasons, but largely because:

- Some ships have taken longer and been more difficult to build than the Navy anticipated,
- Some ships' designs have proved more complicated than expected, and
- The estimated costs of some ships were unrealistically low in earlier shipbuilding plans.

In some cases, CBO's estimates increased more than the Navy's. That is because not all of the Navy's estimates

reflect changing conditions in the shipbuilding industrial base that have caused costs to rise, particularly the cost of building submarines.

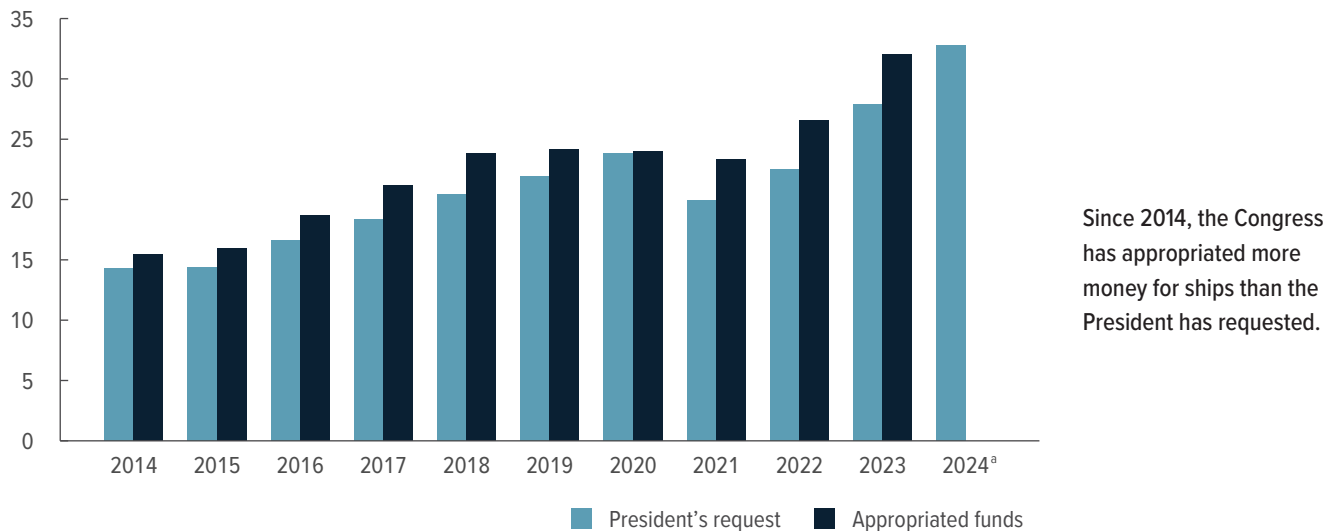
Average Total Shipbuilding Costs Over the Next 30 Years Would Be 31 Percent to 40 Percent More Than Average Appropriations Over the Past 5 Years

Even if the Navy received the same amount of annual funding (in constant dollars) for shipbuilding from 2024 to 2053 that it has received, on average, over the past five years—a half-decade that saw the highest level of such funding since the 1980s—the service still could not afford any of the three alternatives in its 2024 shipbuilding plan. CBO's estimates of the average annual costs of new-ship construction are considerably more than the recent historical average of appropriations for new-ship construction (\$22.8 billion in 2023 dollars)—higher by 31 percent for Alternatives 1 and 2 and by 40 percent for Alternative 3. CBO estimates that if funding for all activities supported by the Navy's shipbuilding account was included in the calculation, the average annual cost of the three alternatives would be \$33.8 billion, \$33.6 billion, and \$36.1 billion, respectively. Those amounts are 33 percent higher for Alternatives 1 and 2, and 43 percent higher for Alternative 3, than the \$25.7 billion the Navy has received in annual appropriations, on average, over the past five years.

Figure 2.

Requested and Appropriated Shipbuilding Budgets, 2014 to 2023

Billions of dollars

Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

a. The 2024 appropriation was not available when this report was published.

The cost of the Navy's 2024 shipbuilding plan is not only high compared with recent funding but also high by historical standards. The recent period used for comparison is one that saw the highest level of funding for ship construction since the Reagan Administration's defense buildup in the 1980s. Since 2014, lawmakers have appropriated, on average, \$2.5 billion more per year for shipbuilding than the President has requested, partly because of concerns that the fleet is too small to perform all of its missions (see Figure 2). And the most recent three years of appropriations—2021, 2022, and 2023—saw three of the four largest increases by the Congress in the past decade. As a point of comparison, shipbuilding appropriations averaged \$29.8 billion (in 2023 dollars) during the Cold War years of 1955 to 1989, a period of intense competition between the United States and the Soviet Union in which the Navy faced challenges that look increasingly similar to those it expects to face over the next two decades.⁵ The three alternatives in the Navy's plan would cost between 13 percent and 21 percent more than that.

Under Each of the 2024 Plan's Alternatives, the Navy Would Need a Larger Total Budget to Operate and Maintain a Larger Fleet

The Department of the Navy's total budget in 2023 is about \$245 billion. As the fleet increased in size, various costs in addition to those for shipbuilding—from operations and support to weapons procurement—would also increase. Fully purchasing, operating, and maintaining any of the larger fleets envisioned in the 2024 plan would require a total annual budget ranging from about \$315 billion to \$330 billion (an increase of roughly 30 percent to 35 percent) by 2053, CBO estimates. Like shipbuilding costs, operation and support costs have historically increased faster than the economywide rate of inflation. Thus, the estimated increase in the Navy's total annual budget is driven both by the costs of acquiring, operating, and maintaining more ships and by annual rates of cost growth that are higher than such rates in the economy as a whole.

The Navy's Uncertain Goals for Shipbuilding

The Navy's specific long-term objectives for its fleet are unclear. Similar to the 2023 plan but unlike those before that, the 2024 shipbuilding plan does not include a specific set of inventory goals, organized by ship type, that would allow for a comparison with the procurement,

5. CBO's historical data for shipbuilding budgets begin with 1955. The year the Berlin Wall fell, 1989, is widely regarded as the end of the Cold War.

delivery, and retirement schedules set forth in its three alternatives. Rather, the 2024 plan states the Navy's intention to develop a new set of force goals, aligned with the 2022 National Defense Strategy, by the summer of 2023.⁶ On June 20, 2023, the Navy submitted that analysis—called the Battle Force Ship Assessment and Requirement (BFSAR) report—to the Congress, but most details were classified. In that report, the Navy set a goal for a fleet of 381 battle force ships. According to the Navy, that effort will shape the 2025 shipbuilding plan, which would normally be submitted in February 2024 with the President's 2025 budget request.

The 2024 plan does not cite or discuss the Navy's or DoD's analyses conducted over the past six years that examined the composition of the future fleet. Rather, the plan states that “multiple threat-informed analyses conducted by the Department of Defense (DoD) as well as external entities underscore the need for a larger, more capable Navy.”⁷

In the 2023 plan, however, those analyses are discussed in some detail (see Table 4). Most of them point to an eventual increase in the number of attack submarines, small surface combatants, small amphibious ships, combat logistics ships, and unmanned surface and undersea vessels, compared with their numbers in today's fleet. The number and types of amphibious warfare ships would also change, but the precise changes are unclear because most of the analyses do not distinguish between midsize amphibious ships, such as LPD-17 amphibious transport docks, and small amphibious ships, such as medium landing ships (which until recently were known as light amphibious warships). The analyses suggest that the Navy would purchase a significant number of those small ships to achieve objectives in the Marine Corps's *Force Design 2030*, including distributing small units of Marines, armed with missile batteries, over a theater of operations.⁸

In addition, in July 2022, the Chief of Naval Operations (CNO) released *Navigation Plan 2022*.⁹ That document outlines shipbuilding goals that are different from the ranges expressed in the shipbuilding plan for fiscal year 2022, which, until the CNO's report was released, was the most recent statement of the Navy's goals for the composition and size of its fleet. The goals in *Navigation Plan 2022* were not tied to the 2023 shipbuilding plan released two months earlier but were informed by an early, classified version of the BFSAR sent to the Congress at the end of July 2022. (The CNO's goals are, however, similar to those in the Navy's 2020 Integrated Force Structure Assessment.)¹⁰ Last year, the Navy indicated that the BFSAR that was then underway would update the force goals discussed in the CNO's report.

The ranges in the 2022 shipbuilding plan and the goals in *Navigation Plan 2022* target the year 2045 as a benchmark for making changes to the fleet. CBO compared the goals in the 2022 shipbuilding plan and those in *Navigation Plan 2022* with the three alternatives in the 2024 plan for the year 2045 (see Table 5). As in the 2023 shipbuilding plan, Alternatives 1 and 2 in the 2024 plan would achieve a fleet similar to the low end of the range in the 2022 shipbuilding plan. Alternative 3 would achieve a fleet similar to the high end of that range and similar to the goals in *Navigation Plan 2022*.

Ship Inventories and Purchases

The Navy's broad goal is to build a larger fleet whose firepower is greater and distributed among more platforms than in today's fleet. The ship purchases and inventories described in the 2024 plan's three alternatives would all attempt to move the future fleet in that direction but in different ways. However, over the next five years, the size of the fleet and its firepower would decrease.

The Navy designed Alternatives 1 and 2 to cost about the same in terms of new-ship construction, whereas under Alternative 3, the Navy would spend an additional \$50 billion to \$66 billion (in 2023 dollars) to

6. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2024* (March 2023), p. 3, <https://tinyurl.com/37bkemd9> (PDF).

7. Ibid.

8. General David H. Berger, Commandant of the Marine Corps, *Force Design 2030: Annual Update* (June 2023), <https://tinyurl.com/y9u4hyzy> (PDF).

9. Chief of Naval Operations, *Navigation Plan 2022* (July 2022), <https://tinyurl.com/waru7vwt> (PDF).

10. Sam LaGrone, “New Navy Fleet Study Calls for 373 Ship Battle Force, Details Are Classified,” *USNI News* (July 19, 2022), <https://tinyurl.com/2p94k2n5>. See also Lara Seligman, Lee Hudson, and Paul McLeary, “Inside the Pentagon Slugfest Over the Future of the Fleet,” *Politico* (July 24, 2022), <https://tinyurl.com/3bra96ex>.

Table 4.

The Navy's Inventory Goals, 2016 to 2022

Number of platforms

	2016 force structure assessment	2020 Future Naval Forces Study, as reported in the December 2020 plan	2022 shipbuilding plan	2020 integrated force structure assessment, as reported in the 2023 plan	Future Naval Forces Study Future Fleet Architecture, as reported in the 2023 plan	Addendum: fleet composition as of October 1, 2023
Combat ships						
Aircraft carriers	12	8 to 11	9 to 11	12	8 to 11	11
Light carriers	n.a.	0 to 6	n.a.	0	0 to 6	0
Submarines						
Ballistic missile	12	12	12	12	12	14
Attack, guided missile, and large payload	66	72 to 78	66 to 72	66	58 to 70	52
Large surface combatants	104	73 to 88	63 to 65	96	72 to 80	87
Small surface combatants and mine countermeasures ships	52	60 to 67	40 to 45	56	47 to 60	31
Large and midsize amphibious warfare ships						
LHAs and LHDs	38	9 to 10	8 to 9	10	6 to 10	9
LPDs and LSDs		52 to 57	16 to 19	41	30 to 43	22
Medium landing ships ^a	0		24 to 35			0
Subtotal, combat ships	284	286 to 329	238 to 268	293	233 to 292	226
Combat logistics and support ships						
Combat logistics	32	69 to 87	56 to 75	45	51 to 85	30
Support	39	27 to 30	27 to 29	52	27 to 51	34
Subtotal, combat logistics and support ships	71	96 to 117	83 to 104	97	78 to 136	64
Total, manned battle force ships	355	382 to 446	321 to 372	390	337 to 404^b	290
Unmanned vessels						
Surface	n.a.	119 to 166	59 to 89	27	81 to 153	0 ^c
Undersea	n.a.	24 to 76	18 to 51	18	18 to 50	0 ^c
Total, unmanned vessels	n.a.	143 to 242	77 to 140	45	99 to 203	0
Total, manned battle force ships and unmanned vessels	355	525 to 688	398 to 512	435	440 to 540	290
Addendum:						
Time frame to achieve the force structure objective	After 2030	2045	2045	After 2030	2045	n.a.

Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

LHAs and LHDs = amphibious assault ships; LPDs = amphibious transport docks; LSDs = dock landing ships; n.a. = not applicable.

a. The Navy previously called these ships light amphibious warships.

b. The total ranges do not represent the sum of the ranges above but rather possible trade-offs among ship types with a fixed budget amount.

c. The Navy is currently experimenting with prototype versions of these vessels.

build new ships over the 30-year period. Generally, Alternative 1 places more emphasis on large surface combatants and small amphibious ships, and on buying more of the next generation of destroyers and attack submarines, than Alternative 2 does. By contrast, Alternative 2 emphasizes undersea warfare the most; the

Navy would buy more submarines than it would under either Alternative 1 or 3. It would, however, buy about half the number of next-generation attack submarines (known as SSN(X)s) that would be purchased under the other alternatives and would instead buy many more Virginia class attack submarines. With more funding,

Table 5.

The Composition of the Fleet in 2045 Under the 2024 Plan Compared With the Navy's Most Recent Shipbuilding Goals

	Navy's 2022 shipbuilding plan, June 2021	Chief of Naval Operations' <i>Navigation Plan</i> 2022, July 2022	Navy's 2024 shipbuilding plan		
			Alternative 1	Alternative 2	Alternative 3
Combat ships					
Aircraft carriers	9 to 11	12	10	10	11 ^a
Submarines					
Ballistic missile	12	12	12	12	12
Attack, guided missile, and large payload	66 to 72	66	55	61	58
Large surface combatants	63 to 65	96	78	74	81
Small surface combatants and mine countermeasures ships	40 to 45	56	44	46	49
Large and midsize amphibious warfare ships					
LHAs and LHDs	8 to 9	10	8	7	9
LPDs and LSDs	16 to 19	21	15	15	17
Medium landing ships	24 to 35	18	25	19	33
Subtotal, combat ships	238 to 268	291	247	244	271
Combat logistics and support ships					
Combat logistics	56 to 75	46	43	51	50
Support	27 to 29	36	28	32	45
Subtotal, combat logistics and support ships	83 to 104	82	71	83	95
Total, battle force ships	321 to 372	373^b	323	327	365
Addendum:					
Time frame to achieve the force structure objective	2045	2045	n.a.	n.a.	n.a.

Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

The Navy's 2022 shipbuilding plan also included 77 to 140 unmanned vessels, and the Chief of Naval Operations' *Navigation Plan 2022* included about 150 unmanned vessels. The 2024 shipbuilding plan would also include roughly 90 to 150 unmanned vessels.

LHAs and LHDs = amphibious assault ships; LPDs = amphibious transport docks; LSDs = dock landing ships; n.a. = not applicable.

- Under Alternative 3, the carrier force would number 10 ships for nearly all years between 2042 and 2053. In 2045, the force would temporarily increase to 11 ships.
- In June 2023, the Navy updated the analysis on which this total was based. Although the details of that analysis are classified, media reports indicate that the Navy has set a goal of 381 battle force ships. The fleet's composition would be similar to that envisioned in *Navigation Plan 2022*.

the Navy would buy more of all types of ships under Alternative 3 than under Alternatives 1 or 2—except for submarines. Although the 2024 plan provides few details about the future of unmanned vessels, it reports that “the Navy could achieve 89–149 unmanned platforms by 2045” and that large numbers of LUSVs are the preferred alternative for increasing the fleet's offensive missile capability.¹¹

This report assesses the costs of implementing each of the three alternatives in the Navy's 2024 plan, the alternatives' effects on its force structure, and the capabilities that the alternatives would bring to the fleet. CBO did not evaluate the validity of the Navy's analysis of its future force structure or the fleet's ability to fulfill its missions in the national military strategy.

Combat Ships

Combat ships include aircraft carriers, submarines, large and small surface combatants, and amphibious warfare ships. Over the next 30 years, the Navy would

11. See Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2024* (March 2023), pp. 7 and 9, <https://tinyurl.com/37bkemd9> (PDF).

buy 237 combat ships under Alternative 1, 243 under Alternative 2, and 267 under Alternative 3. Those purchases would leave the Navy with fewer carriers, large surface combatants, and large amphibious warfare ships than it currently has, but the number of attack submarines (including guided missile and large payload submarines) and small surface combatants would increase. The number of amphibious warfare ships would also increase, although the composition of the amphibious warfare force would differ significantly from that of today's force (see Figure 3).

Aircraft Carriers. Currently, the Navy's carrier force consists of 10 Nimitz class carriers and 1 Gerald R. Ford class ship. Over the next 30 years, the Navy would purchase 6 Ford class aircraft carriers (1 every five years, starting in 2028) under Alternatives 1 and 2 and would purchase 7 of them (1 every four years) under Alternative 3 (see Figure 4, first panel). All three alternatives would allow the Navy to maintain the size of its existing force of 11 aircraft carriers through 2039, as new Ford class carriers replaced Nimitz class ships.¹² After that, under Alternatives 1 and 2, the force would fall to 10 carriers and then, for most years between 2046 and 2053, to 9 carriers. Under Alternative 3, the force would remain at 10 or 11 carriers for nearly every year through 2053.

Ballistic Missile Submarines. The plan for the Columbia class ballistic missile submarines (SSBNs), which are slated to replace the Navy's 14 Ohio class submarines as they retire, is the same under all three alternatives. The Navy ordered the first of the Columbia class ships in 2021; the 2024 plan calls for purchasing another one in 2024 and then 10 more, at a rate of 1 per year, between 2026 and 2035. Unlike the goals for other categories of ships, force goals for SSBNs are not determined by the Navy's force structure assessments but rather by requirements that stem from the number of submarines needed on station by DoD's Strategic Command and, secondarily, by the operational availability of those ships. Therefore, the Navy's requirement to replace its 14 Ohio class SSBNs with 12 Columbia class ships has been set for many years and remains unchanged.

12. Under all three alternatives, the carrier force would briefly dip to 10 carriers in 2027, although the Navy is examining whether it can extend the life of a retiring carrier for a short period to keep the force at 11 ships.

The Navy estimates that the lead Columbia class submarine (a lead ship is the first ship of its class) will take at least seven years to build, so the first one would be commissioned into the fleet in 2028. Another two or three years of testing, training, and preparing the ship for deployment would elapse, however, before it went on its first deterrent patrol. Subsequent submarines in the class would each take about seven years to build and test. Over the past two years, the Navy has determined that it could extend the service life of 5 Ohio class submarines by two to three years each so that the SSBN force would remain at 12 ships or more for all but three years between 2024 and 2053.

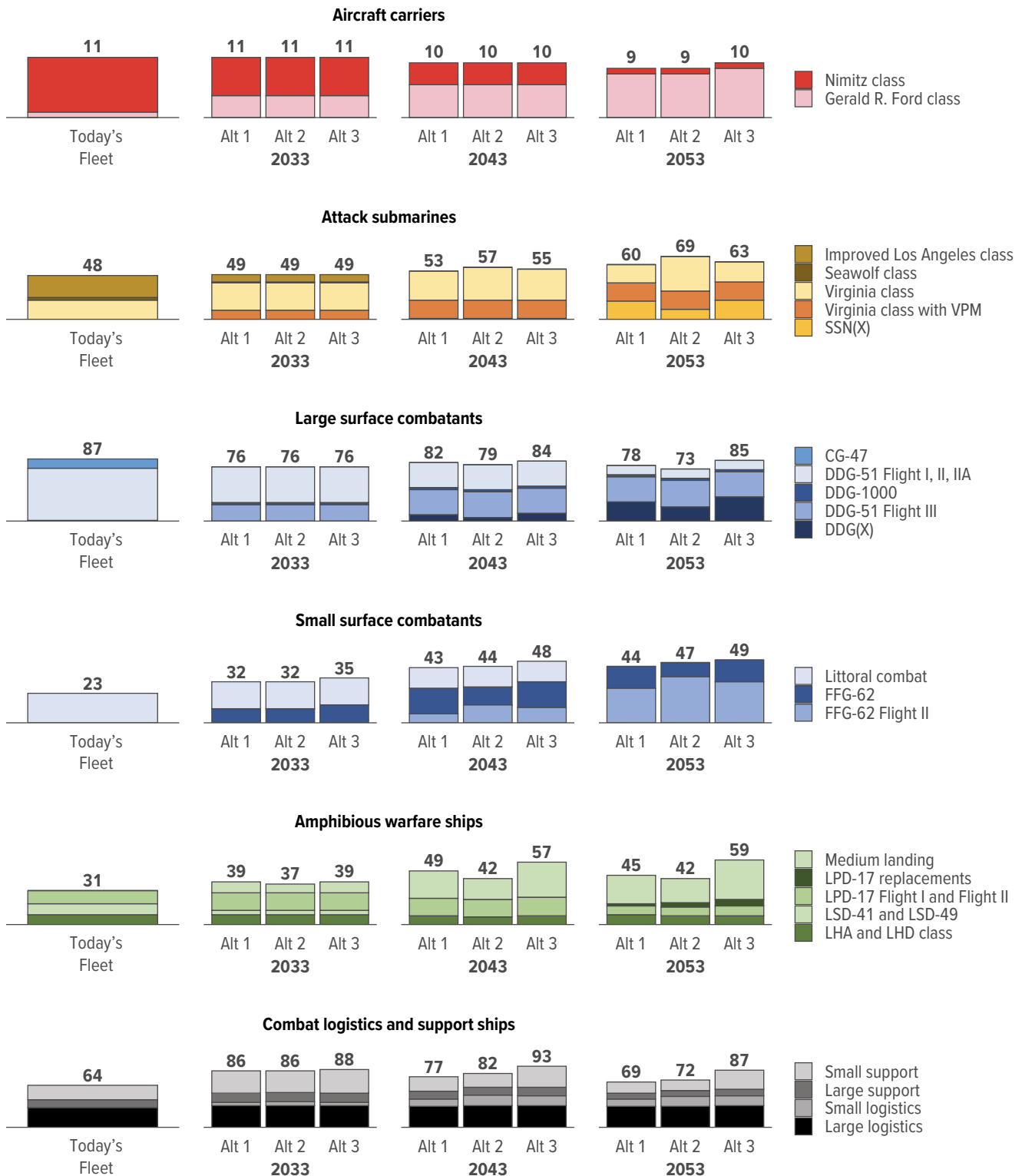
Attack and Large Payload Submarines. The Navy currently has 48 nuclear-powered attack submarines (SSNs): 24 Los Angeles class, 3 Seawolf class, and 21 Virginia class ships.¹³ The fleet also includes 4 guided missile submarines (SSGNs), which are converted Ohio class ballistic missile submarines that can carry large numbers of conventional missiles and special operations forces. According to the 2024 shipbuilding plan, after an initial decline to 46 SSNs in 2030, the SSN force would become larger and more capable than it is today. Under Alternative 1, the Navy would buy 54 SSNs and would have 60 in the fleet by 2053 (see Figure 3, second panel). Under Alternative 2, the Navy would buy the most SSNs, purchasing 66 of them over the next 30 years. In that case, the force would reach 60 SSNs by 2045 and 69 by 2053. Under Alternative 3, the Navy would purchase 58 SSNs; its inventory would reach 60 ships by 2048 and 63 ships by 2053.

The composition of the SSN force, however, would be different depending on which alternative was implemented. Under Alternatives 1 and 3, the Navy would invest more heavily in next-generation SSN(X) submarines, buying nearly twice as many of them as it would under Alternative 2. By contrast, under Alternative 2, the Navy would buy more submarines overall but would continue production of the Virginia class submarines without the Virginia payload module (VPM) through

13. For an overview of those programs, see Ronald O'Rourke, *Navy Virginia-Class Submarine Program and AUKUS Submarine Proposal: Background and Issues for Congress*, Report RL32418, version 259 (Congressional Research Service, October 23, 2023), <https://tinyurl.com/vbhy77ax>, and *Navy Next-Generation Attack Submarine (SSN[X]) Program: Background and Issues for Congress*, Report IF11826, version 24 (Congressional Research Service, August 4, 2023), <https://tinyurl.com/2p8asnmm>.

Figure 3.

Inventories of Selected Categories of Ships Under the Navy's 2024 Plan

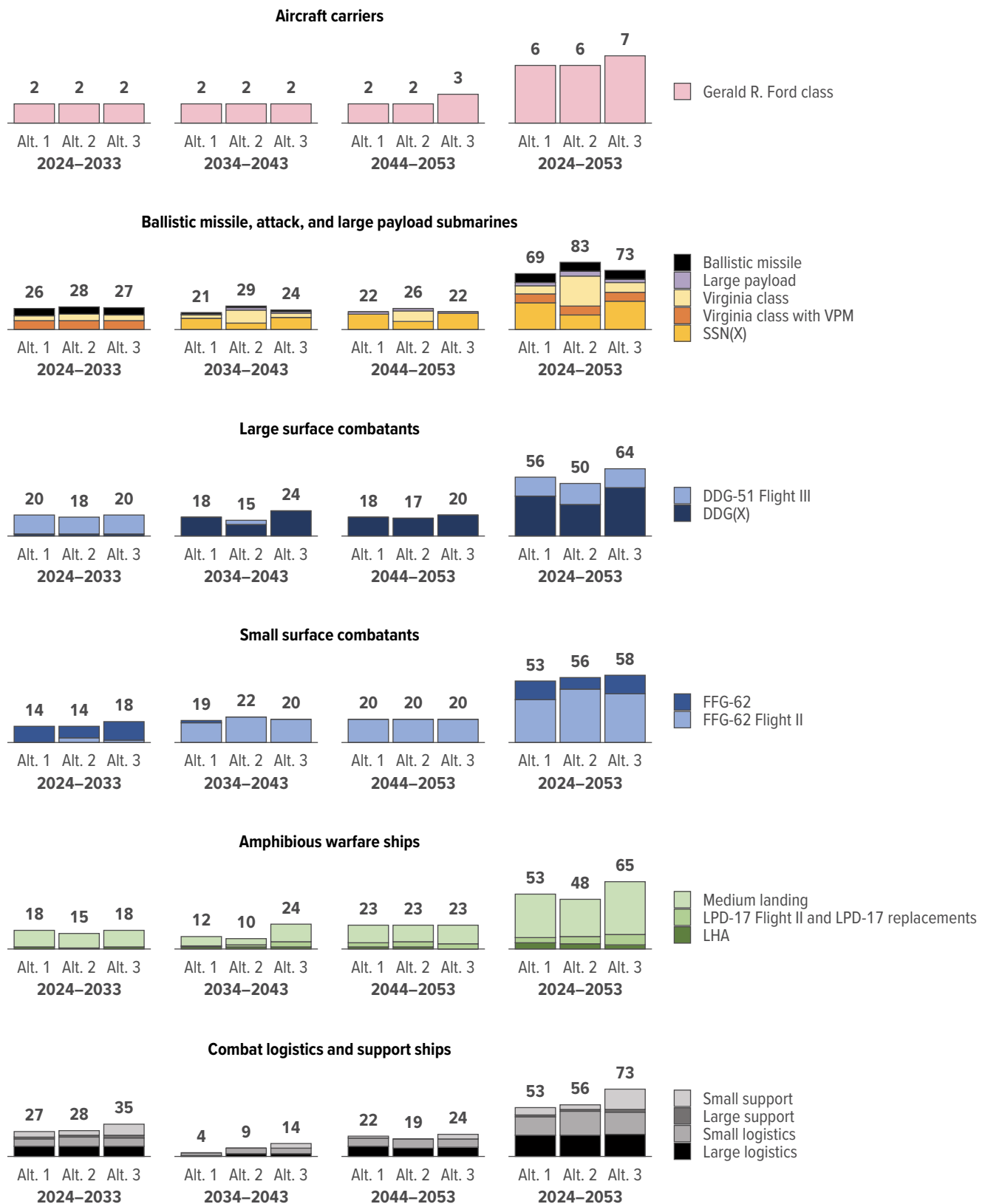


Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/59508#data.

CG = guided missile cruiser; DDG = guided missile destroyer; DDG(X) = next-generation destroyer; FFG = guided missile frigate; LHA and LHD = amphibious assault ship; LPD = amphibious transport dock; LSD = dock landing ship; SSN(X) = next-generation attack submarine; VPM = Virginia payload module.

Figure 4.

Purchases of Selected Categories of Ships Under the Navy's 2024 Plan



Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/59508#data.

DDG = guided missile destroyer; DDG(X) = next-generation destroyer; FFG = guided missile frigate; LHA = amphibious assault ship; LPD = amphibious transport dock; SSN(X) = next-generation attack submarine; VPM = Virginia payload module.

2053.¹⁴ It would also begin production of the SSN(X) in 2035 (one year later than under the 2023 plan), as it would under the other two alternatives.

According to the 2024 plan, the Navy would also build a new large payload submarine starting in the 2030s or 2040s, depending on which alternative was implemented. That new ship would be a large-capacity submarine, perhaps built on a Columbia class hull in much the same way that the Navy's existing SSGNs are converted from Ohio class SSBNs. The new ships would be bought in small numbers, with 1 ship being built every three or four years under each alternative. The Navy would purchase 4 large payload submarines through 2053 under Alternatives 1 and 3 and would purchase 6 of them under Alternative 2.

The 2024 plan's implications for the submarine industrial base are considerable. The Navy currently takes six to nine years to build a new submarine. That means that for a few years in the 2030s, five types of submarines (including both SSBNs and large payload submarines) would be in production under Alternatives 2 and 3; four types of ships would be in production throughout much of that decade under Alternative 1. Alternative 2 would see three types of ships in production in the 2040s and beyond, whereas under Alternatives 1 and 3, just two types of ships would be in production by about 2045. With three types of submarines currently in production (Columbia class, Virginia class, and Virginia class with VPMs), the Navy is experiencing cost overruns, construction delays, and missed delivery dates. Adding more classes of ships to the pipeline could tax the ability of the shipyards and the Navy to manage production even more.¹⁵ In addition, under the 2024 plan, the quantity

of submarine construction (as measured in thousands of tons of Condition A-1 weight, which is analogous to the measure of lightship displacement for surface ships) would increase by more than 50 percent over the next decade.

Large Surface Combatants. The Navy currently has 87 cruisers and destroyers in its fleet. However, all 13 of its remaining CG-47 Ticonderoga class cruisers are to be retired over the next five years (4 were retired earlier this year). All three alternatives in the 2024 shipbuilding plan would reduce the number of large surface combatants, consistent with most of the Navy's recent analyses. By 2033, the large surface combatant force would fall to 76 ships under all three alternatives (see Figure 3 on page 11, third panel). By 2053, the force would range from a low of 73 ships under Alternative 2 to a high of 85 ships under Alternative 3. That would mean fewer ships under all three alternatives than in the current force but more than envisioned in the 2023 plan.

Under Alternative 1, the Navy would buy 56 destroyers over the next 30 years at a rate of slightly less than 2 ships per year; under Alternative 2, it would buy 50 ships at a rate of 1 or 2 per year (see Figure 4 on page 12, third panel). The Navy would buy the most large surface combatants—64 ships—under Alternative 3, purchasing slightly more than 2 ships per year over the 30-year period. Under all three alternatives, it would continue to buy DDG-51 Flight III Arleigh Burke class destroyers in about equal numbers. And—also in all three cases—purchases of the next-generation DDG(X) destroyer would begin in 2032, making the start date of its construction two years later than under the 2023 plan.¹⁶ The number of DDG(X)s purchased under the three alternatives would vary; the Navy would buy the fewest, 30, under Alternative 2 and the most, 46, under the larger budgets of Alternative 3.

Small Surface Combatants. The Navy now has 23 littoral combat ships (LCSs), categorized as small surface combatants, in its fleet and also operates 8 mine countermeasures ships, which it sometimes includes in that category. (CBO does not include mine countermeasures ships in its tally of small surface combatants.) Another 5 LCSs and 4 FFG-62 Constellation class

14. The Virginia payload module adds four large-diameter payload tubes to the existing Virginia class submarine; each tube can carry seven Tomahawk missiles or other payloads, such as unmanned underwater vessels. That modification would increase the submerged displacement of the submarine by nearly 30 percent and would increase the number of the Virginia class submarine's Tomahawk-sized vertical-launch weapons from 12 to 40. The submarines would be armed with approximately 25 additional weapons—torpedoes and Tomahawks—in the torpedo room.

15. For further background, see Anthony Capaccio, "New U.S. Nuclear-Missile Submarines Hobbled by Billions in Growing Costs and Delays," *Bloomberg* (June 8, 2022), <https://tinyurl.com/bddkjtdj>; Megan Eckstein, "Submarine Industrial Base Under Strain as Virginia-Class Parts Wearing Out Early; Implications for Columbia-Class," *USNI News* (April 20, 2021), <https://tinyurl.com/ycf2hfz2>; and Congressional Budget Office, *The Capacity of the Navy's Shipyards to Maintain Its Submarines* (March 2021), www.cbo.gov/publication/57026.

16. For more about the earlier start date of the DDG(X), see Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2023 Shipbuilding Plan* (November 2022), www.cbo.gov/publication/58447.

frigates are being built. Under all three alternatives in the 2024 plan, the number of LCSs would fall as 7 ships were retired over the next three years in addition to the 4 retired in 2023; all of the ships to be retired would be less than 10 years old.¹⁷ The Navy would keep just 21 of the 35 LCSs it will have built until the end of their planned 25-year service life.

According to the 2024 plan, the number of small surface combatants would roughly double, by 2053, to a force of 44 under Alternative 1, 47 under Alternative 2, and 49 under Alternative 3 (see Figure 3 on page 11, fourth panel). That would put the size of the force near the middle of the ranges in the Navy's recent analyses of its future fleet—a larger force, for example, than envisioned in the 2022 shipbuilding plan but a smaller one than in the 2020 Future Naval Forces Study, as reported in the December 2020 plan.¹⁸

The composition of the small surface combatant force would vary among the three alternatives. Under Alternative 1, the Navy would purchase 16 FFG-62s through 2035 (in addition to the 4 frigates already under construction) before switching to an upgraded design of that ship, designated as the FFG-62 Flight II (see Figure 4 on page 12, fourth panel). Under Alternative 2, the Navy would buy only 10 FFG-62s through 2030. It would start buying the upgraded version in 2029, acquiring 46 of the Flight IIs in total. The service would buy 16 FFG-62s under Alternative 3 before switching to the Flight II ship. In all three cases, ships would be purchased at a rate of 1 or 2 per year through the mid-2030s, then largely at a rate of 2 per year thereafter.

Amphibious Warfare Ships. The Navy's current amphibious warfare force comprises 31 ships: 9 large amphibious assault ships, designated as LHAs or LHDs; 12 midsize amphibious transport docks, or LPDs; and 10 midsize dock landing ships, or LSDs. Under the three alternatives in the 2024 plan, the number of those

ships would be reduced and, as first proposed in the Navy's December 2020 plan, a major building program for small amphibious ships (called medium landing ships—LSMs—which were previously referred to as light amphibious warships) would begin. The number of large and midsize amphibious ships would fall to 29 by 2033 (which is 5 more than under the 2023 plan) and then to between 23 and 25 ships by 2043. By 2053, those ships would number 19, 20, and 23 under Alternatives 1, 2, and 3, respectively. By contrast, the LSM program would slowly grow to 10 ships by 2033 under Alternatives 1 and 3 and to 8 ships under Alternative 2. By 2053, the Navy would have the most LSMs, 35, under Alternative 3 and the fewest, 22, under Alternative 2.¹⁹

Under Alternative 1, the Navy would buy a total of 11 large and midsize amphibious warfare ships; it would buy 12 under Alternative 2 and 14 under Alternative 3—about the same numbers as under the 2023 plan but fewer than envisioned in earlier plans (see Figure 4 on page 12, fifth panel). Under all three alternatives, the Navy would buy 1 or 2 LSMs per year, starting in 2025. But because the LSMs would have only a 20-year service life, the Navy would need to start buying replacements for the first class of ships in the 2040s. Overall, the Navy would buy 42, 36, and 51 LSMs under Alternatives 1, 2, and 3, respectively.

Combat Logistics and Support Ships

The Navy's combat logistics and support ships include large ships, such as T-AO oilers and T-AKE dry cargo ships, which resupply vessels at sea, and smaller ships, such as tug and salvage ships, surveillance craft, and expeditionary fast transports. Under the alternatives in the 2024 plan, the Navy would increase the number of large oilers and begin buying a smaller logistics ship, called the next-generation logistics ship and currently designated as a T-AOL (which in the past was called a light oiler), to help resupply a larger fleet with more smaller warships. Overall, the Navy would buy 53 combat logistics and support ships under Alternative 1, 56 under Alternative 2, and 73 under Alternative 3 (see Figure 4 on page 12, sixth panel).

17. Retiring ships at such a young age is unusual. Thus, some members of Congress have objected to the Navy's plan; the House Armed Services Committee proposed to prohibit the retirement of 5 of those ships in its version of the 2023 National Defense Authorization Act.

18. Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2022 Shipbuilding Plan* (September 2021), www.cbo.gov/publication/57414, and *An Analysis of the Navy's December 2020 Shipbuilding Plan* (April 2021), www.cbo.gov/publication/57091.

19. In the 2024 plan, for reasons that are unclear, the Navy characterizes the LSMs as support ships rather than as small amphibious ships. However, CBO continues to categorize those ships as amphibious warfare ships, as does the Congressional Research Service, to more accurately reflect the missions they would perform.

Most of the differences in the three alternatives' plans for combat logistics and support ships are attributable to two types of ships: the T-AOL and the expeditionary fast transport. The Navy would buy 20 T-AOLs under Alternative 1 and 26 of them under Alternative 2. Despite building a larger overall combat fleet under Alternative 3, the Navy would buy only 24 T-AOLs in that case. As with the LSMs, some of those ships would be replacements because the T-AOLs have an expected service life of 20 years. The Navy would maintain a force of 11 T-AOLs under Alternative 1, 16 under Alternative 2, and 15 under Alternative 3. The service would also purchase 14 replacements for its expeditionary fast transports under Alternative 3; it would buy 2 such replacements in 2053 under Alternative 1 but would buy no replacements under Alternative 2.

Unmanned Surface and Undersea Vessels

In last year's shipbuilding plan, the Navy discussed the potential of unmanned systems to contribute to its overall capabilities. Specifically, it mentioned the value of medium unmanned surface vessels (MUSVs) as sensor platforms, large unmanned surface vessels as "adjunct missile magazines teamed with larger manned multi-mission platforms," and extra-large unmanned undersea vessels as having "the capability to deliver multiple payloads at extended ranges."²⁰ The plan also noted, however, that because those programs are still being developed and their technological success is not completely assured, the future quantities of ships and costs associated with them had not yet been determined.

The Navy still has not announced how many MUSVs it would purchase (other than the first prototype), and it is not clear whether the Navy would purchase those vessels using its shipbuilding account or some other account. Thus far, the Navy has purchased unmanned undersea vessels through its other procurement account instead of its shipbuilding account. The unmanned surface and undersea vessels mentioned in the Navy's shipbuilding report are much larger than the single-use, expendable drones used in the war in Ukraine and would be a permanent part of the service's fleet.²¹

The 2024 plan does not repeat that specific language about unmanned systems. Rather, it discusses various technologies that the Navy is actively investing in to ultimately build a "hybrid fleet." Such a force would combine large numbers of manned and unmanned ships to "build a more lethal and distributed naval force."²² Information provided to CBO by the Navy included the assumption that the service would buy 2 LUSVs per year under Alternative 1, and 3 per year under Alternatives 2 and 3. Because those vessels have a 20-year service life, those purchases would result in a force of 40 LUSVs under Alternative 1 and 60 under the other two alternatives. The 2024 report included no information on the number of MUSVs or large undersea unmanned vessels the service would purchase. However, the 2024 plan states that the service could have between 90 and 150 unmanned platforms by 2045, which suggests that the number of MUSVs and undersea platforms combined could amount to between 50 and 90 vessels, once the LUSVs were accounted for.

Shipbuilding Costs

According to the Navy's estimates, its planned purchases of new ships from 2024 to 2053 would cost (that is, require appropriations of), on average, \$25.9 billion per year under Alternative 1, \$26.4 billion under Alternative 2, and \$28.1 billion under Alternative 3—all in 2023 dollars (see Figure 5). Those amounts represent an increase of 9 percent, 10 percent, and 7 percent, respectively, compared with the alternatives in the 2023 plan, after adjusting for inflation. The increase in the Navy's costs is largely attributable to higher estimates for its shipbuilding programs, especially for attack submarines.

CBO estimated the costs of the three alternatives in the 2024 plan using its own models and assumptions.²³ On average, CBO's estimates of annual costs for new-ship construction over the 30-year period are higher than the Navy's estimates by \$4.4 billion (or 17 percent) for Alternative 1, \$3.8 billion (or 14 percent) for Alternative 2, and \$4.5 billion (or 16 percent) for Alternative 3. Other activities the Navy would need to fund from its budget account for ship construction add

20. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2023* (April 2022), p. 6, <https://go.usa.gov/xJtjj> (PDF).

21. Emmanuel Grynszpan and Marie Jégo, "In the Black Sea, Ukraine Attacks the Russian Fleet With Naval Suicide Drones," *Le Monde* (August 5, 2023), <https://tinyurl.com/2x52bp8v>; and Nathan Rennolds, "Ukraine's Hi-Tech Naval Attack Drones Have Paralyzed Russia's Black Sea Fleet, Spy Chief Says," *Business Insider* (August 26, 2023), <https://tinyurl.com/3cv4f6r4>.

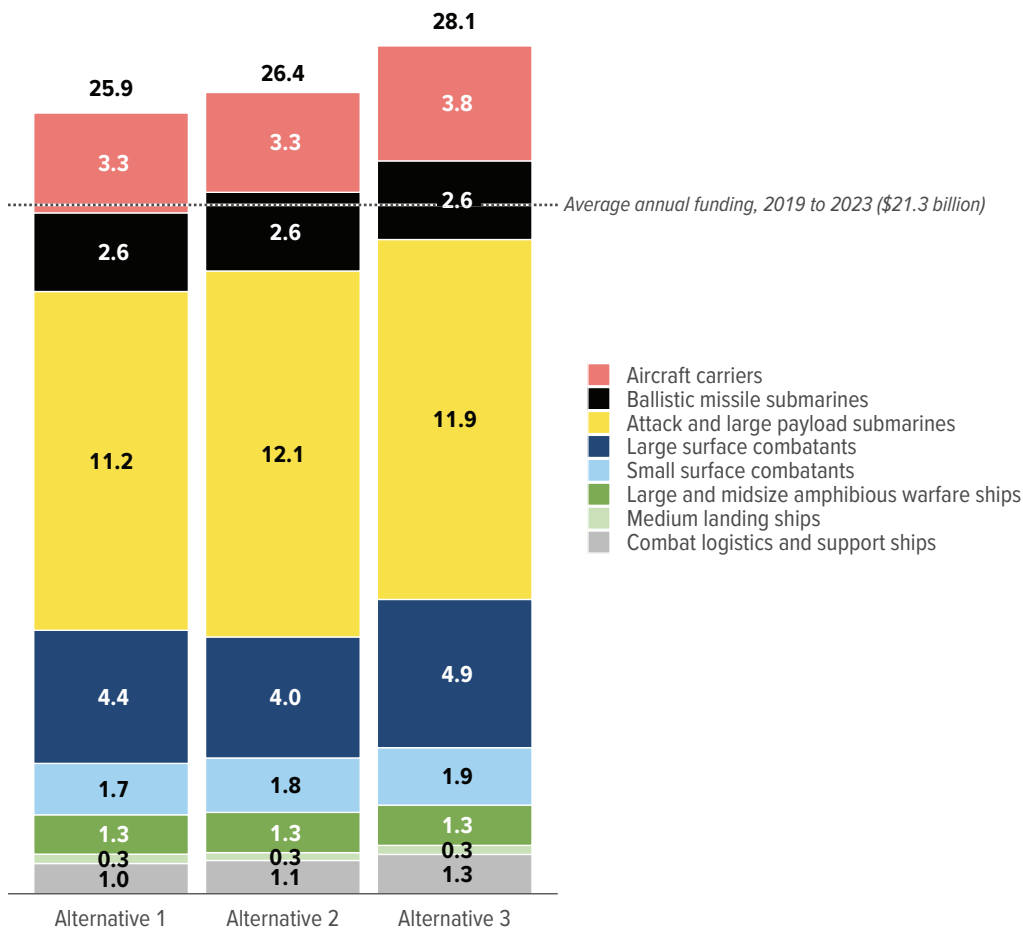
22. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2024* (March 2023), p. 8, <https://tinyurl.com/37bkemd9> (PDF).

23. For more information about how the agency estimates shipbuilding costs, see Congressional Budget Office, *How CBO Estimates the Costs of New Ships* (April 2018), www.cbo.gov/publication/53785.

Figure 5.

The Navy's Estimates of Average Annual Costs of New-Ship Construction Under Its 2024 Plan, by Ship Type

Billions of 2023 dollars



The Navy estimates that building new ships would cost from \$26 billion to \$28 billion per year, on average, under the three alternatives in its 2024 plan.

Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/59508#data.

roughly \$3.5 billion per year to projected costs. Thus, combining the service's estimates for new-ship construction costs and CBO's estimates for other costs leads to a total average annual cost for all activities typically funded from the Navy's shipbuilding account that ranges from \$29.1 billion to \$31.4 billion, or 6 percent to 9 percent more than under the 2023 plan. CBO's estimates are 14 percent to 16 percent more per year, on average, than the Navy's.

Both CBO's and the Navy's estimates increased largely because of higher estimates for shipbuilding programs, especially submarine programs. Approximately 80 percent of the increase in CBO's estimates for Alternatives 1 and 2 is attributable to higher unit prices; the rest is attributable to changes in quantities of various

types of ships. For Alternative 3, nearly all of the increase in estimated costs is attributable to higher unit prices. And submarine programs account for about 80 percent of the increase that is due to higher unit prices across the alternatives.

The Navy's Estimates

The Navy's 2024 plan delineates future shipbuilding procurements, retirements, and inventories under all three alternatives. The plan also emphasizes (as have recent shipbuilding plans) the importance of providing steady work to the shipbuilding industry as a way to prevent boom-and-bust cycles, which could jeopardize the financial health of some shipyards and secondary suppliers and create uncertainty about the cost of shipbuilding in the future. The Navy also notes that the quantities and

Table 6.

Cost Overruns and Unit Cost Growth for Selected Navy Shipbuilding Programs

Programs requiring prior-year shipbuilding funding in the 2024 Future Years Defense Plan to complete ships authorized and appropriated before 2024	
	Cost overrun (millions of 2023 dollars)
Gerald R. Ford class CVN-78 aircraft carrier	582
Nimitz class CVN-68 aircraft carrier nuclear refueling and overhaul	194
Virginia class SSN-774 attack submarine	857
Arleigh Burke class DDG-51 guided missile destroyer	696
Freedom class LCS-1 littoral combat ship	21
San Antonio class LPD-17 amphibious transport dock	55
America class LHA-6 amphibious assault ship	65
John Lewis class T-AO-205 oiler	155
Najavo T-ATS-6 towing, salvage, and rescue ship	10
T-AGOS SURTASS ship	323
LCAC ship-to-shore connector	100

Programs experiencing substantial growth in their unit prices in the 2024 Future Years Defense Plan over the past five years, after adjusting for inflation	
	Unit cost growth (percent)
Nimitz class CVN-68 aircraft carrier nuclear refueling and overhaul	15
Virginia class SSN-774 attack submarine	15
John Lewis class T-AO-205 oiler	38
Najavo T-ATS-6 towing, salvage, and rescue ship	22
LCU-1700 utility landing craft	33

Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

delivery times of new ships in its plan are predicated on the assumption that the production delays plaguing several shipyards today will be resolved, leading to the steady and on-time delivery of new ships in the future.²⁴

New-Ship Construction Costs. According to estimates in the Navy’s 2024 plan, submarine construction would consume the lion’s share of shipbuilding funds over the next 30 years—about half of the amount needed for new-ship construction under each alternative. The estimates reflect the fact that, other than aircraft carriers, submarines are the most expensive ships the Navy buys, and it plans to buy many of them regardless of which alternative it follows. The focus on submarines also reflects the importance of undersea warfare in the service’s evolving naval strategy and vision for its future fleet.

The Navy has increased its cost estimates for several major shipbuilding programs, including the program for Virginia class attack submarines. The estimated cost of the 2 Virginia class submarines the Navy proposes to buy in 2025 is 15 percent more than the Navy’s estimated costs for 2 submarines purchased in 2019. Higher costs in the Virginia class program caused the Navy’s estimate for the SSN(X) to increase substantially and may similarly affect estimates for Columbia class ballistic missile submarines. (The Navy will update its cost estimate for the Columbia class program later this year.) Nor are ships under construction immune from this phenomenon. Over the next five years, every major ongoing shipbuilding program will require additional money to complete ships that were authorized in prior years’ budgets (see Table 6).

According to the Navy, submarines would account for 54 percent of the cost of new-ship construction under Alternative 1, 56 percent under Alternative 2, and 52 percent under Alternative 3. The Navy would spend the least amount on submarines under Alternative 1, about \$13.8 billion per year, and would buy the fewest of them. The greater number of submarines purchased

24. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2024* (March 2023), pp. 9–10, <https://tinyurl.com/37bkemd9> (PDF). Detailed cost projections are provided in Appendix 6 of the report; that appendix is a limited-distribution document that the Navy made available to CBO.



under Alternative 2 would cost an average of \$14.7 billion per year. Although the Navy would purchase 8 fewer submarines under Alternative 3 than under Alternative 2, it would spend almost the same amount per year on them, \$14.5 billion, because it would buy fewer Virginia class SSNs and would invest more heavily in the (more expensive) next-generation SSN(X)s.

That spending pattern is reversed in the case of surface combatants. Under Alternative 1, the Navy would spend proportionally more (24 percent of construction costs) on surface combatants than it would under Alternative 2 (22 percent of construction costs)—a difference amounting to \$300 million per year, on average. Under Alternative 3, it would spend 24 percent of construction costs on surface combatants—about \$700 million more per year than would be spent under Alternative 1 and \$1.0 billion more per year than under Alternative 2.

In general, according to the Navy's estimates, spending on the remaining categories of ships is proportionally about the same under all three alternatives. Amphibious ships represent 6 percent of new-ship construction costs, and combat logistics and support ships represent 4 percent to 5 percent of such costs.

The balance of the greater overall cost of Alternative 3—\$66 billion more, over 30 years, than Alternative 1 and \$50 billion more than Alternative 2—would be spent on smaller and less expensive ships, the Navy estimates. The average overall cost of a ship under the Navy's alternatives ranges from \$2.5 billion to \$2.7 billion. The average cost of the *additional* ships that would be purchased under Alternative 3 ranges from \$1.2 billion to \$1.3 billion, according to the Navy's estimates.

Total Shipbuilding Costs. As in all previous shipbuilding plans, estimates in the Navy's 2024 plan exclude certain costs that would need to be paid from its budget account for shipbuilding. Specifically, they exclude the costs of refueling nuclear-powered aircraft carriers, purchasing ships that are not part of the battle force (such as oceanographic survey ships or sealift ships), outfitting and post-delivery activities (including the purchase of many small tools and equipment needed to operate a ship but that are not necessarily provided by the shipyard when the ship is built), and other smaller items. In addition, the Navy's estimates do not include the \$3.2 billion needed

(because of cost overruns or other increased expenses) to complete ships authorized before 2024, nor do they include the \$1.0 billion in investments in the submarine industrial base. Including all those costs, as estimated by CBO, would add \$3.2 billion to \$3.3 billion each year to the Navy's estimates. Using both sets of estimates, the total annual costs for all activities funded through the Navy's shipbuilding account would average \$29.1 billion under Alternative 1, \$29.6 billion under Alternative 2, and \$31.4 billion under Alternative 3.

CBO's Estimates

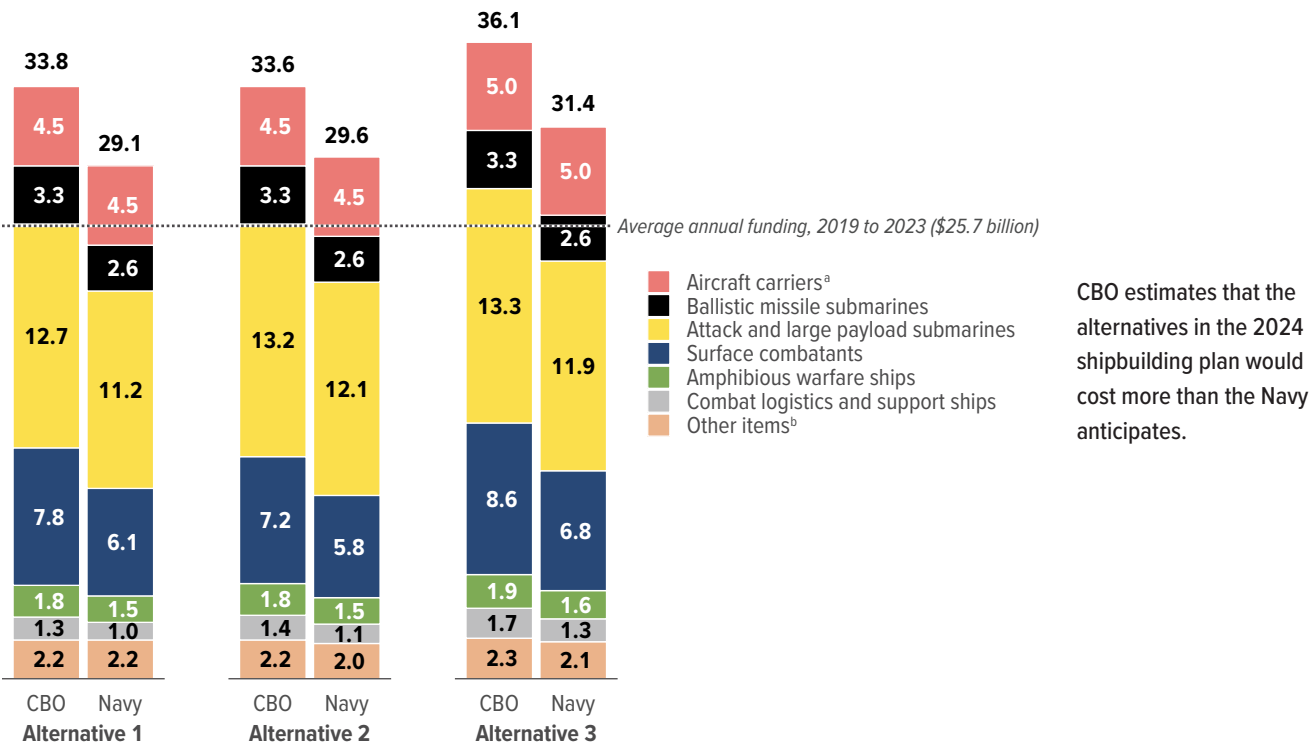
According to CBO's estimates, the full cost of the 2024 shipbuilding plan (including new-ship construction, refueling of aircraft carriers, and other items) over the 2024–2053 period would average \$33.8 billion per year under Alternative 1, \$33.6 billion under Alternative 2, and \$36.1 billion under Alternative 3. Those amounts range from 31 percent to 40 percent more than the average annual funding the Navy has received over the past five years (see Figure 6). They are also about 5 percent to 10 percent greater than CBO's estimates of the 2023 plan, after adjusting for inflation. CBO's estimates (like the Navy's) reflect the expectation that the production delays plaguing several shipyards today would be resolved over the next decade, leading to the steady and on-time delivery of new ships. If that did not happen, costs for new ships could be higher than the Navy and CBO estimate, and the delivery of new ships would take longer than anticipated in the 2024 plan.

The gap between CBO's and the Navy's estimates widens over time. For the 2024–2033 period, CBO's estimates of total shipbuilding costs are 9 percent to 10 percent higher than the Navy's, but they are 19 percent to 20 percent higher over the 2044–2053 period (see Table 7). The two sets of estimates are closer in the near term because most of the ships the Navy plans to buy are already under construction and their costs are reasonably well known. But CBO and the Navy made different assumptions about the size and capabilities of future ships, which led to differing cost estimates for the midterm and far term. In particular, two large programs—the new attack submarine and the next-generation destroyer—account for about half of the difference between the Navy's and CBO's cost estimates under Alternatives 1 and 3 and for more than one-third of that difference under Alternative 2.

Figure 6.

Average Annual Total Shipbuilding Costs Under the Navy’s 2024 Plan, as Estimated by CBO and the Navy

Billions of 2023 dollars



Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/59508#data.

- a. Includes funding for building new aircraft carriers as well as refueling the nuclear power plants of aircraft carriers already in the fleet.
- b. Includes construction of ships that are not part of the Navy’s battle force (such as oceanographic survey ships or sealift ships), outfitting and postdelivery activities (including the purchase of smaller tools and pieces of equipment that are needed to operate a ship but that are not provided by the manufacturing shipyard as part of ship construction), efforts to extend ships’ service life, service craft, and smaller items.

A significant portion of the difference in estimates for those two programs is attributable to CBO’s treatment of cost growth that is greater than inflation in the economy as a whole. When estimating the cost to build a ship in the future that is identical to one already built, the Navy reports the future cost of capabilities purchased as being the same as the cost today. By contrast, CBO projects the cost to build the same ship in the future by accounting for the rising costs of labor and materials used in building naval ships (that is, shipbuilding inflation) compared with the rising costs of other goods and services in the economy. CBO regards that difference between shipbuilding inflation and overall inflation as growth in the constant-dollar cost of building naval ships.

For this report, CBO used the historical difference between shipbuilding inflation and inflation in gross

domestic product (GDP) prices, as measured by the GDP price index, to calculate the growth in its constant-dollar estimates of shipbuilding programs. Between 1993 and 2022, shipbuilding inflation outpaced inflation in the economy by an average of about 1.1 percent per year. CBO’s projections of shipbuilding costs reflect the assumption that the same rate of difference would continue between 2024 and 2053. As a result, the agency estimated that a ship that costs \$2.5 billion to build in 2023 would cost \$3.2 billion (in 2023 dollars) in 2045. (However, shipbuilding costs cannot continue to grow faster than the costs of goods and services in the economy as a whole indefinitely. If that occurred, the price of ships would eventually outstrip the Navy’s ability to pay for even a small number of them unless its shipbuilding budget grew commensurately with shipbuilding costs.)

Table 7.

Average Annual Total Shipbuilding Costs Under the Navy's 2024 Plan

	Near term (2024–2033)	Midterm (2034–2043)	Far term (2044–2053)	All three decades (2024–2053)
Navy's estimates (billions of 2023 dollars)^a				
Alternative 1	30.1	26.2	31.0	29.1
Alternative 2	30.1	28.4	30.5	29.6
Alternative 3	31.5	31.2	31.3	31.4
CBO's estimates (billions of 2023 dollars)				
Alternative 1	33.1	30.9	37.3	33.8
Alternative 2	32.8	31.7	36.3	33.6
Alternative 3	34.6	36.3	37.6	36.1
Difference between the Navy's and CBO's estimates (percent)				
Alternative 1	10	18	20	16
Alternative 2	9	12	19	13
Alternative 3	10	16	20	15

Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

a. These figures include the Navy's estimates for new-ship construction and amounts to complete ships purchased in prior years, as well as CBO's estimates for the refueling of nuclear-powered aircraft carriers, ships that are not counted in the battle force, outfitting of new ships, and other items.

Growth in the Navy's Total Annual Budget

The larger fleets envisioned under all three alternatives in the 2024 plan would increase costs in other parts of the Navy's budget as the fleets grew. Fully purchasing, operating, and maintaining those larger fleets would, in CBO's estimation, increase the Navy's total annual budget by about 30 percent, from \$245 billion today to between \$315 billion and \$330 billion (in 2023 dollars) in 2053. Shipbuilding costs would account for about 12 percent of that amount for 2053. (Operating and crewing the larger fleets under the Navy's alternatives would represent the largest components of the Navy's budget—representing about 46 percent of the total.) Costs would decrease slightly in the 2020s as the number of ships in the fleet declined and as the Navy retired ships that were more expensive to operate than the new ones it would commission. But in the 2030s and beyond, costs would increase (see Figure 7).

To estimate growth in the Navy's total budget, CBO independently developed estimates for each of the service's budget accounts. Specifically, to estimate costs associated with the shipbuilding and aircraft procurement accounts, CBO first estimated the cost of each ship and aircraft procurement program.²⁵ Estimates for other

items or activities purchased through those accounts, as well as the remaining procurement accounts, were developed on the basis of historical relationships between the accounts and the shipbuilding and aircraft procurement accounts.

CBO estimated costs for operation and maintenance accounts on the basis of historical relationships between those costs and the size of the Navy's fleet, as measured by its total full-load displacement for surface ships and submerged displacement for submarines. Estimates for the Navy's military personnel accounts were based on the historical relationship between the total number of sailors serving on ships and the total number of service members. Estimates for Marine Corps military personnel were based on historical averages adjusted for the size of the Corps, which is set by law. Estimates for the remaining accounts, such as the one for military construction, were based on historical averages.

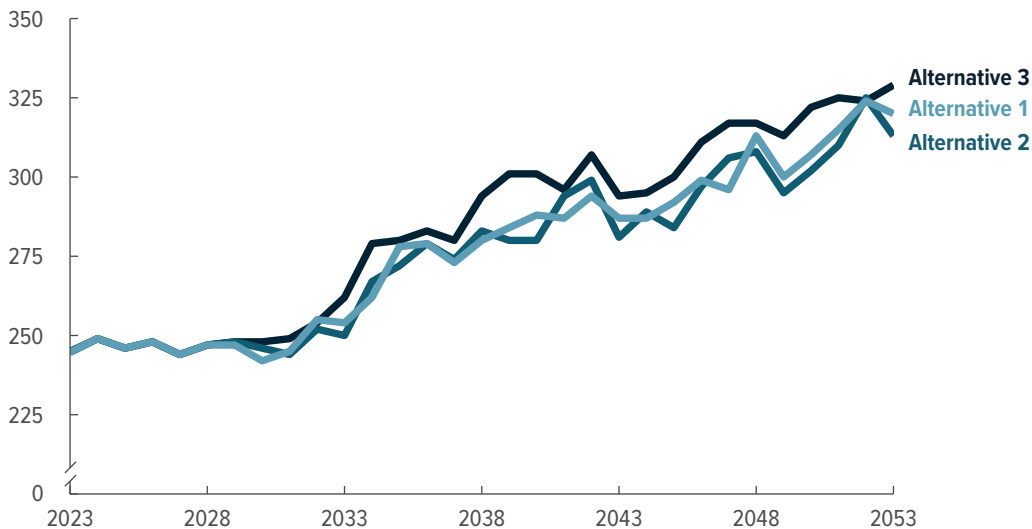
CBO adjusted its estimates to vary with changes in the Navy's fleet over time (specifically, changes in ship and aircraft procurements, ship displacements, and crew sizes). In addition, costs paid from most of the Navy's accounts have seen inflation greater than that in the economy as a whole; those differences are included as real growth (that is, growth adjusted to remove the effects of inflation) in the estimates.

25. The estimates for aircraft are drawn from and are consistent with those published in Congressional Budget Office, *The Cost of Replacing Today's Naval Aviation Fleet* (January 2020), www.cbo.gov/publication/55949.

Figure 7.

CBO's Estimate of the Navy's Total Budget Under Its 2024 Plan

Billions of 2023 dollars



As the fleet grew in size under the alternatives in the 2024 plan, the Navy's total budget would grow from \$245 billion to between \$310 billion and \$330 billion by 2053.

Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/59508#data.

Measures of Capability

In the absence of a force structure assessment, the Navy compared its three alternatives using several measures of capability. By emphasizing different types of ships in Alternatives 1 and 2, and by allocating additional resources in Alternative 3, the Navy sought to illustrate several trade-offs in the lethality of its fleet. Specifically, it counted the number of:

- Vertical launch missile cells on surface ships,
- Vertical launch missile cells on submarines,
- Torpedoes on attack submarines, and
- Tactical aircraft sorties launched from the carrier force per day.

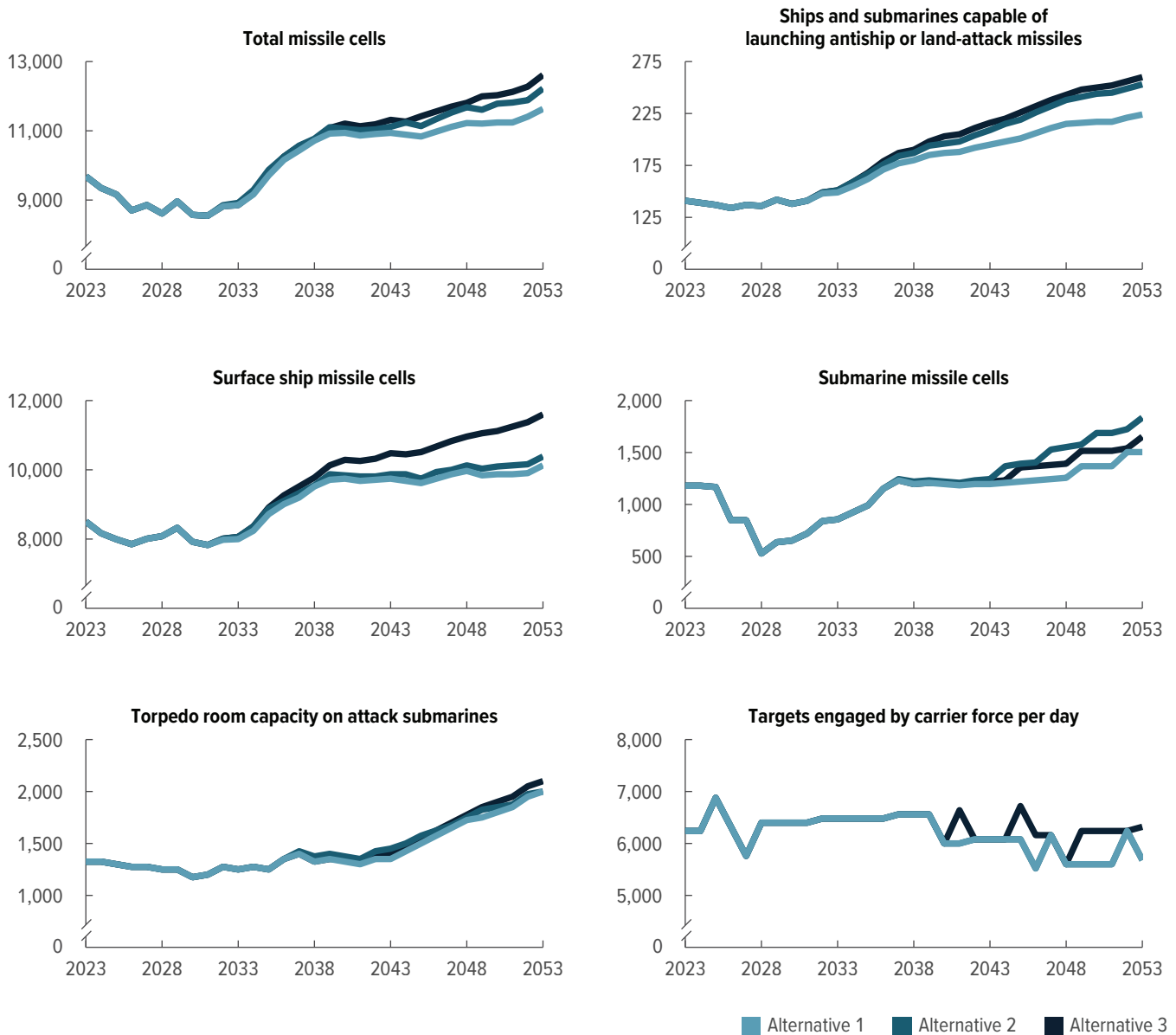
Although those four metrics measure the *lethality* of the fleet, none of them address the *distribution* of its firepower—an important element of the Navy's Distributed Maritime Operations concept. Thus, to compare the three alternatives, CBO counted the number of ships capable of firing antiship or land-attack missiles. The agency also calculated the total missile capability of the Navy's fleet, combining the vertical launch capability of surface ships and that of submarines.

Under all three alternatives in the 2024 plan, the lethality of the fleet, as measured in part by the total number of missile cells, would decline by 12 percent until 2032 (see Figure 8).²⁶ That is because the Navy would retire more cruisers, destroyers, and submarines than it would commission over the next 10 years. For example, undersea missile capacity would decline, as the Navy's 4 guided missiles submarines, or SSGNs, which each carry up to 154 land-attack missiles, were retired in the mid-2020s. That capability is set to be replaced by Virginia class attack submarines modified to carry up to 40 missiles each. However, the first of those submarines would not enter the fleet until November 2028. After 2032, the missile capacity of the fleet would grow again. By 2053, the fleet would have 20 percent more vertical launch system (VLS) cells than it does today under

26. Missile cells refer to the number of vertical launch system (VLS) cells carried by the Navy's surface combatants, submarines, or unmanned systems. Using the number of VLS cells in the fleet as a measure of lethality reflects an assumption that the Navy has sufficient munitions to fill those cells and that the ships carrying them have a reasonable prospect of being effective in performing their missions. In fact, the Navy is planning to increase its missile purchases. For a more thorough discussion of the advantages and disadvantages of using VLS cells as a measure of capability, see Congressional Budget Office, *Comparing a 355-Ship Fleet With Smaller Naval Forces* (March 2018), p. 11, www.cbo.gov/publication/53637.

Figure 8.

Measures of Naval Capability Under the Navy's 2024 Plan



By most measures, the capability of the Navy's fleet would decline during the next decade before increasing beyond that of today's fleet.

Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/59508#data.

Alternative 1, 26 percent more under Alternative 2, and 30 percent more under Alternative 3. The other metrics related to missile cells illustrate the trade-offs between missile cells on surface ships and those on submarines. For example, Alternative 1 would provide more VLS cells on manned surface ships than Alternative 2,

which would provide more of them on submarines. But the larger unmanned LUSV force envisioned under Alternative 2 would provide slightly more VLS cells on all surface ships as well.

With respect to the distribution of that lethality, the Navy's alternatives would fare much better. Through 2026, the fleet would experience a 5 percent decline in the number of ships capable of launching antiship and land-attack missiles, compared with today's fleet. By 2053, however, that number, in relation to today's fleet, would increase by 59 percent under Alternative 1, by 79 percent under Alternative 2, and by 84 percent under Alternative 3.

The fleet's torpedo capacity would substantially increase under all three alternatives because of their emphasis on purchasing submarines. That metric highlights the potential increase in the Navy's ability to conduct under-sea warfare between now and 2053. Under all three alternatives, more submarines would be retired than commissioned over the next decade; but after that, torpedo room capacity would increase, compared with the amount in today's fleet, by about 50 percent to 60 percent.

Finally, the number of targets the carrier force could attack each day would not change much under the alternatives in the 2024 plan. The Navy would have the same size carrier force under Alternatives 1 and 2; but under Alternative 3, the fleet would include, on average, 1 additional carrier by the late 2040s—the result of building 1 carrier every four years after 2028. Although the Ford class carriers are expected to be capable of launching more daily aircraft sorties than Nimitz class carriers can, the carrier force would decline to 9 or 10 ships under all three alternatives by the 2040s. As a result, the overall capability of the carrier force would not change much or would decline slightly by 2053.

Plans for Specific Ship Programs

To project the costs of implementing the alternatives in the Navy's 2024 shipbuilding plan, CBO estimated the cost of each ship the Navy intends to purchase between 2024 and 2053. For ships under construction, the estimates were based in part on the Navy's data about actual costs. For ships yet to be built, CBO based the estimates primarily on information about the cost-to-weight ratio of similar ships acquired in the past.

Specifically, the agency used the cost per thousand tons of lightship displacement, which is the weight of the water a ship displaces without its crew, stores, ammunition, fuel, or other liquids. CBO then adjusted its estimates to reflect the effects of rate and learning. Rate is the reduction in average overhead costs that occurs as a shipyard builds multiple ships of the same type

simultaneously; learning refers to the efficiencies that shipyards gain as they produce additional ships of a given type. Those effects were applied to the estimated cost of the first ship of a class to estimate the costs for all subsequent ships of that class. Thus, CBO's estimate of the cost of the lead ship of a class drove its estimate of the costs of subsequent ships of that class.²⁷

For ships that have yet to be designed, CBO developed its estimates on the basis of the ships' likely size and capabilities. All cost estimates for specific ships exclude outfitting and postdelivery costs, which typically add 3 percent to a ship's cost (included as "other items" in estimates of total costs). CBO's estimates also reflect the expectation that costs of labor and materials would continue to grow at a rate that is 1.1 percent faster in the naval shipbuilding industry than in the economy as a whole, the rate at which such costs have grown for the past several decades.

Aircraft Carriers

Over the 2024–2053 period, the Navy would buy 6 CVN-78 Ford class aircraft carriers under Alternatives 1 and 2 and would buy 7 of them under Alternative 3. To project the costs of those ships, CBO considered the costs of the first 4 carriers of the class, which have already received some or all of their funding.

The first ship of the class, the USS *Gerald R. Ford* (CVN-78), cost \$13.3 billion in nominal dollars appropriated between 2001 and 2021.²⁸ CBO used the Navy's inflation index for naval shipbuilding to convert that amount to \$18.6 billion (in 2023 dollars)—which is 27 percent more than the Navy's corresponding estimate when the ship was first authorized in 2008.²⁹ Neither the Navy's nor CBO's estimate includes the \$6 billion in research and development costs that apply to the entire class of ships. Because construction of the lead ship is finished, CBO used the end cost for that ship to estimate the cost of successive ships in the class.

27. For an explanation of how CBO combines the different factors in its cost model, as well as a detailed example of that process applied to a particular ship, see Congressional Budget Office, *How CBO Estimates the Costs of New Ships* (April 2018), www.cbo.gov/publication/53785.

28. That amount does not include costs paid from other Navy accounts to make the ship operational after it was commissioned.

29. For more information about calculating the costs of aircraft carriers, see Congressional Budget Office, *Inflation in the Costs of Building Aircraft Carriers* (April 2016), www.cbo.gov/publication/51469.

The next carrier slated for delivery, the *John F. Kennedy* (CVN-79), is expected to be completed in 2024 and deployed in 2026. The Congress first appropriated advance procurement funding for the ship in 2007, officially authorizing its construction in 2013. As a result of cost overruns, the planned appropriations for the ship are expected to be completed in 2024. The Navy estimates that the ship will cost \$14.8 billion (in 2023 dollars, or \$12.7 billion in nominal dollars). CBO's estimate for the ship is almost the same: \$14.9 billion (in 2023 dollars).³⁰

In 2018, the Congress authorized the third carrier of the class, the *Enterprise* (CVN-80). Appropriations for that ship began in 2016 and are expected to be complete by 2025. In 2019, the Congress authorized the Navy to purchase materials jointly for the CVN-80 and the next ship, the CVN-81, to save money by buying in greater quantities. It also authorized the Navy to change the sequencing involved in building the ships to gain greater efficiencies in their construction. Although that legislative action is known as a two-carrier buy, the ships would not be built at exactly the same time. Purchasing the two ships together would accelerate the CVN-81's construction by only one year, compared with buying them individually.

In the 2024 budget, under the two-carrier buy, the Navy estimated that the CVN-80 will cost \$12.3 billion (in 2023 dollars, or \$12.6 billion in nominal dollars). By contrast, CBO is less certain about the savings the two-carrier purchase will generate. On the basis of the costs of the two previous ships, CBO estimates that the CVN-80 will cost \$14.0 billion (in 2023 dollars), about 13 percent more than the Navy's estimate. Similarly, the Navy estimates that the CVN-81 will cost \$12.0 billion (in 2023 dollars, or \$12.9 billion in nominal dollars). By contrast, CBO estimates that the CVN-81 will cost \$13.6 billion (in 2023 dollars), which is also 13 percent more than the Navy's estimate.

The Navy's estimates for future carriers are much higher than its estimates for the CVN-80 or CVN-81. In the 2024 shipbuilding plan, the Navy estimates that the 6 carriers purchased under Alternatives 1 and 2 would each cost about \$17 billion (in 2023 dollars), on average, and the 7 carriers purchased under Alternative 3 would

each cost about \$16 billion (see Table 8). The difference between those two estimates for the alternatives is driven largely by the effect of building carriers every five years under the first two alternatives versus every four years under the third alternative. The Navy expects that if future carriers can be purchased repeatedly using the two-carrier buy strategy over the next 30 years, then the costs could be lower than the estimates provided in the 2024 plan.

In a report to the Congress, the Navy estimates that a two-ship buy strategy would save about 7 percent, if the carriers were purchased every five years. If those ships were purchased every four years, then the estimated savings would double, to about 14 percent under Alternatives 1 and 2. Under Alternative 3, the savings would be a little less than 7 percent because the Navy already envisions buying carriers every four years under that alternative.³¹ Even so, the Navy's recent estimates suggest that the industry is experiencing growth in real costs. The increase in its estimates for the 2024 plan, compared with those in the 2023 plan, amounts to roughly \$500 million more per ship than is accounted for by shipbuilding inflation alone (using the same assumptions about how frequently the Navy would buy the ships).

CBO estimates that under the first two alternatives, carriers would cost, on average, \$16.6 billion—3 percent less than the Navy's estimate. CBO's estimate for carrier purchases under the third alternative is \$15.7 billion per ship—2 percent less than the Navy's estimate. Although using the two-carrier buy strategy should generate savings, it is not clear that the large savings the Navy anticipates would occur. The savings that could be realized with two-carrier buys will be better understood once the CVN-80 and CVN-81 are complete.

Submarines

Under all three alternatives in the 2024 plan, the Navy would buy 11 new Columbia class submarines over the next 15 years. (The first Columbia class ship was ordered in 2021.) In addition, the service plans to purchase 4 or 6 large payload submarines (depending on which alternative is implemented) that could carry large numbers of missiles or special operations forces.

30. In its report on the fiscal year 2020 shipbuilding plan, CBO's estimate was 9 percent higher than the Navy's. See Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2020 Shipbuilding Plan* (October 2019), p. 18, www.cbo.gov/publication/55685.

31. Department of the Navy, *Report to the Congress: Report on Advance Procurement for CVN 82 and CVN 83* (undated). The undated report was sent to the Congress in July 2023 by the Under Secretary of the Navy.

By far the greatest difference among the three alternatives is in the category of attack submarines. Under Alternative 1, the Navy would continue to buy Virginia class submarines with the Virginia payload module until 2029. After that, it would purchase Virginia class ships without the VPM before switching to the new and much more capable SSN(X) in 2035. The Navy would follow the same schedule under Alternative 3, although it would buy slightly more of each type of submarine. Alternative 2 would also follow that schedule but differs significantly from the other alternatives regarding the quantities and types of submarines purchased starting in 2035: The Navy would buy many more Virginia class submarines through 2053 and about half the number of SSN(X)s.

A major uncertainty in the Navy's plans for attack submarines is the effects of the tripartite security arrangement between Australia, the United Kingdom, and the United States known as AUKUS. See Box 1 for a discussion of how AUKUS could affect the size of the U.S. attack submarine force.

Ballistic Missile Submarines. SSBNs, which carry Trident ballistic missiles, constitute the sea-based component of the United States' strategic nuclear triad. (The other two components are land-based intercontinental ballistic missiles and strategic bombers.) The cost of the 11 Columbia class submarines included in the 2024 shipbuilding plan is one of the most significant uncertainties in the Navy's and CBO's analyses of future shipbuilding costs. Under the 2024 plan, the second Columbia class ship to be built would be purchased in 2024; 1 ship per year would then be purchased from 2026 to 2035.³²

The Navy currently estimates that construction of the first Columbia class ship, the *District of Columbia*, will be complete in 2028 at a cost of \$15.8 billion (in 2023 dollars). As of June 30, 2023, the ship was 36 percent complete. Subsequent ships in the class would cost \$7.7 billion, on average. The total procurement cost for the 12 submarines would be \$100.2 billion (which includes appropriations of \$21.4 billion from 2017 to 2023), or \$8.4 billion per ship, on average.

According to the Navy's estimate, the cost per thousand tons of displacement for the first Columbia class ship would be 13 percent less than that of the first Virginia class attack submarine. But the costs of lead ships of new classes of submarines built in the 1970s and 1980s provide little evidence that ballistic missile submarines are cheaper to build, per ton, than attack submarines. On the basis of a calculation of cost risk completed in October 2022, the Navy has stated that there is a 54 percent chance that the cost of the first Columbia class submarine will exceed its estimates and a 46 percent chance that it will cost less than estimated. The likelihood that subsequent ships in the class would cost more or less than estimated was nearly even—49 percent and 51 percent, respectively.

Moreover, the Navy's estimates for Columbia class ships have not yet been updated to reflect existing conditions in the submarine industrial base. As previously mentioned, the Navy estimates that the Virginia class submarines it will buy in 2025 and 2026 will cost about 15 percent more than the ones purchased in 2022 and 2023, after adjusting for inflation. The Navy has attributed a large portion of that increase in the cost of future Virginia class submarines to poor performance in the building shipyards, a fragile industrial base for suppliers of many components, and other challenges. Columbia class ships are being built in those same shipyards and will probably be affected by the same conditions. Nevertheless, the Navy continues to rely on its 2021 cost estimate for the Columbia class, which it plans to update later this year.

CBO's estimate for the Columbia class program reflects current industry conditions and is therefore 19 percent greater than the Navy's. CBO estimates that purchasing the first Columbia class submarine would cost \$17.5 billion—\$1.7 billion more than the Navy estimates. Including appropriations from 2017 to 2023, CBO estimates that, all told, 12 Columbia class submarines would cost \$119 billion (of which \$100 billion would be appropriated between 2024 and 2036). The 11 submarines set to follow the lead ship would cost \$9.2 billion each, on average—\$1.5 billion more per submarine than the Navy estimates.

Costs for the Columbia class submarines could, however, exceed both the Navy's and CBO's estimates. The new SSBN will be the largest, most technologically complex submarine the United States has ever built. It is expected to reuse some technology and components from the

32. For additional information, see Ronald O'Rourke, *Navy Columbia (SSBN-826) Class Ballistic Missile Submarine Program: Background and Issues for Congress*, Report R41129, version 245 (Congressional Research Service, October 2, 2023), <https://go.usa.gov/xSvDe>.

Table 8.

Comparison of the Navy's and CBO's Estimates of the Construction Costs of Major New Ships Under the Navy's 2024 Plan

Billions of 2023 dollars

Ship class	Number of ships purchased	Total costs per class over the 2024–2053 period		Average costs per ship over the 2024–2053 period	
		Navy’s estimates	CBO’s estimates	Navy’s estimates	CBO’s estimates
Alternative 1					
CVN-78 Gerald R. Ford class aircraft carriers ^a	6	100	99	17.0	16.6
SSBN-826 Columbia class ballistic missile submarines ^b	11	79	100	7.7	9.2
Large payload submarines	4	30	37	7.7	9.3
SSN-774 Virginia class attack submarines with VPMS	11	43	47	3.9	4.3
SSN-774 Virginia class attack submarines ^c	10	40	41	3.9	4.1
SSN(X) next-generation attack submarines	33	222	256	6.7	7.8
DDG-51 Flight III Arleigh Burke class destroyers	18	38	39	2.1	2.2
DDG(X) next-generation destroyers	38	93	130	2.5	3.4
FFG-62 Constellation class frigates	16	16	19	1.0	1.2
FFG-62 Flight II frigates	37	36	45	1.0	1.2
LHA-6 America class amphibious assault ships ^d	6	27	30	4.3	4.7
LPD(X) next-generation amphibious ships	5	12	13	2.3	2.7
LSM medium landing ships	42	8	11	0.2	0.3
T-AO-205 John Lewis class oilers	11	8	9	0.8	0.8
T-AOL next-generation logistics ships	20	7	10	0.4	0.5
T-AKE(X) replenishment ships	12	9	12	0.8	1.0
Alternative 2					
CVN-78 Gerald R. Ford class aircraft carriers ^a	6	99	99	17.0	16.6
SSBN-826 Columbia class ballistic missile submarines ^b	11	79	100	7.7	9.2
Large payload submarines	6	44	53	7.6	8.8
SSN-774 Virginia class attack submarines with VPMS	11	43	47	4.0	4.3
SSN-774 Virginia class attack submarines ^c	37	150	151	4.0	4.1
SSN(X) next-generation attack submarines	18	126	143	7.0	8.0
DDG-51 Flight III Arleigh Burke class destroyers	20	44	45	2.2	2.2
DDG(X) next-generation destroyers	30	76	106	2.5	3.5
FFG-62 Constellation class frigates	10	10	14	1.0	1.2
FFG-62 Flight II frigates	46	44	54	1.0	1.2
LHA-6 America class amphibious assault ships ^d	5	23	26	4.3	4.8
LPD(X) next-generation amphibious ships	7	15	18	2.2	2.6
LSM medium landing ships	36	7	9	0.2	0.3
T-AO-205 John Lewis class oilers	12	9	10	0.8	0.8
T-AOL next-generation logistics ships	26	10	12	0.4	0.5
T-AKE(X) replenishment ships	11	8	12	0.8	1.1

Continued

Virginia class submarine, but it would also include many new elements, such as an all-electric drive system, an X-stern ship control system (in which the rear rudders and dive planes are shaped like an “X” rather than a “+”, as they are on the Ohio class submarines), a new missile compartment, and a nuclear reactor designed to last the entire 42-year service life of the submarine. Furthermore, the Navy has repeatedly stated that the Columbia is its

first acquisition priority and that the program must stay on schedule to meet its strategic deterrence mission. Thus, if the program encounters problems in construction, the Navy and the shipbuilders are likely to invest more resources and assign more people to the program to meet the schedule, all of which would increase costs. Conversely, costs for the Columbia class ships could be less than CBO estimates if the Navy and the shipbuilders

Table 8.

Continued

Comparison of the Navy's and CBO's Estimates of the Construction Costs of Major New Ships Under the Navy's 2024 Plan

Billions of 2023 dollars

Ship class	Number of ships purchased	Total costs per class over the 2024–2053 period		Average costs per ship over the 2024–2053 period	
		Navy’s estimates	CBO’s estimates	Navy’s estimates	CBO’s estimates
Alternative 3					
CVN-78 Gerald R. Ford class aircraft carriers ^a	7	113	106	16.0	15.7
SSBN-826 Columbia class ballistic missile submarines ^b	11	79	100	7.7	9.2
Large payload submarines	4	31	34	7.7	9.0
SSN-774 Virginia class attack submarines with VPMs	11	43	47	4.0	4.3
SSN-774 Virginia class attack submarines ^c	12	48	47	4.0	4.0
SSN(X) next-generation attack submarines	35	235	268	6.7	7.7
DDG-51 Flight III Arleigh Burke class destroyers	18	38	39	2.1	2.2
DDG(X) next-generation destroyers	46	109	149	2.4	3.2
FFG-62 Constellation class frigates	16	16	18	1.0	1.1
FFG-62 Flight II frigates	42	41	50	1.0	1.2
LHA-6 America class amphibious assault ships ^d	4	18	20	4.1	4.4
LPD(X) next-generation amphibious ships	10	22	25	2.2	2.5
LSM medium landing ships	51	10	13	0.2	0.3
T-AO-205 John Lewis class oilers	12	9	9	0.8	0.8
T-AOL next-generation logistics ships	24	9	12	0.4	0.5
T-AKE(X) replenishment ships	12	9	12	0.8	1.0

Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

Amounts shown exclude funding for research and development.

CVN = nuclear-powered aircraft carrier; DDG = guided missile destroyer; FFG = guided missile frigate; LHA = amphibious assault ship; LPD = amphibious transport dock; SSBN = ballistic missile submarine; SSN = attack submarine; T-AKE(X) = future dry cargo ship; T-AO = oiler; T-AOL = light oiler or next-generation logistics ship; VPM = Virginia payload module.

- In CBO's and the Navy's estimates for aircraft carriers, total costs per class under all three alternatives include remaining funding for the CVN-80 and CVN-81 authorized before 2024 but exclude some funding for the carrier the Navy would purchase in 2052 under Alternative 3 and the carrier purchased in 2053 under Alternatives 1 and 2 because that money would not be budgeted until 2054 or later. Estimates for the average cost per ship exclude the CVN-80 and CVN-81 but include all funding for the carrier that would be bought in 2052 or 2053 under the alternatives.
- In CBO's and the Navy's estimates for ballistic missile submarines, total costs exclude \$19.2 billion in funding appropriated before 2024 for the first and second ships of the class, and average costs per ship exclude the cost of the first ship of the class, which was authorized in 2021.
- In 2024, the Navy would purchase 2 Virginia class submarines, one of which is designated to be a subsea and seabed warfare submarine. Although it would be similar in size to a Virginia class submarine with VPM, it would have different capabilities. Thus, CBO included that submarine in its count of regular Virginia class submarines rather than as a Virginia class ship with VPM but excluded it from the calculation of the average cost per submarine.
- CBO's and the Navy's estimates of total costs for amphibious assault ships include funding that is to be appropriated in 2024 for a ship that the Congress authorized in 2020. Estimates of the average cost per ship exclude that funding.

are successful in their ongoing efforts to increase the speed and efficiency of construction and to improve the performance of the supplier base.

Large Payload Submarines. As with previous shipbuilding plans, the alternatives in the 2024 plan include a program to buy “large payload-based submarines.”³³ The

ships would probably perform missions similar to those currently conducted by SSGNs and, in the future, by Virginia class ships with VPMs, as well as other missions. The first ship would be ordered after production of the Columbia class ceased—in 2042 under Alternative 1, in 2037 under Alternative 2, and in 2038 under Alternative 3. The Navy would then purchase 1 ship every three or four years through 2053 for a total of 4 ships under Alternatives 1 and 3, and 6 ships under Alternative 2.

33. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2024* (March 2023), p. 15, <https://tinyurl.com/37bkemd9> (PDF).

Box 1.

The Potential Effect of the AUKUS Security Pact on the U.S. Navy's Inventory of Attack Submarines

In September 2021, the governments of Australia, the United Kingdom, and the United States announced they were forming a pact, known as AUKUS, to promote security and deterrence in the Western Pacific region. The pact comprises two groups of cooperative endeavors, or “pillars.” The aim of Pillar 1 is for the United States and the United Kingdom to help Australia establish an industrial base for nuclear-powered attack submarines. The ships would eventually be built using a British design, modified in part with technology from U.S. Virginia class submarines. Pillar 2 focuses on cooperation in several high-technology areas, including cyber, artificial intelligence, undersea capabilities, offensive and defensive hypersonic weapons, electronic warfare, and others.

Because Australia could take decades to build its own attack submarines, the pact calls for the United States to sell a limited number of Virginia class nuclear-powered attack submarines (SSNs) to Australia as an interim step. Though details of the sale, including the cost of the ships and the timing of deliveries, are still undetermined, some Australian and U.S. government officials have suggested that the first ships would be transferred in the early 2030s. The sale could involve as few as 3 used submarines or as many as 5 submarines, which would include used and newly built ships.

The Navy's 2024 shipbuilding plan states that the service “anticipates building additional Virginia class SSNs in the 2030s as replacements for submarines sold to Australia.”¹ Those replacement submarines are not included in the 2024 plan's three alternative long-range projections of the Navy's future fleet. According to that plan, between 2030 and 2039, the Navy would buy 16 SSNs under Alternative 1, 21 under Alternative 2, and 18 under Alternative 3. To purchase 3 to 5 additional replacement submarines during that period, the Navy would need to build 1.9 to 2.6 SSNs per year, depending on which alternative it followed.

However, the U.S. submarine industrial base is currently struggling to meet the Navy's demand for submarines. Since 2011, the Congress has authorized and appropriated funds for the Navy to buy 2 Virginia class submarines per year and to begin building a class of 12 Columbia class ballistic missile submarines (SSBNs). The Navy ordered the first Columbia class ship in 2021 and expects to order the second in 2024; the remaining

ships are scheduled to be ordered between 2026 and 2035 at a rate of 1 ship per year. Currently, the shipyards are building fewer than 1.5 SSNs per year in addition to beginning construction of Columbia class ships and are facing a backlog of work. Over the past several years, the time between the appropriation of funds for SSNs and their delivery has increased from six years (when the Navy was building 1 SSN per year) to nine years. Therefore, it would be very difficult and expensive for the U.S. submarine industry to increase production of attack submarines during a period when it must also build 1 Columbia class ship per year. (Columbia class SSBNs are two and one-half times the size of Virginia class SSNs.) Moreover, SSBNs are the Navy's highest acquisition priority. As a result, the sale of SSNs to Australia would reduce the number of attack submarines available to the Navy.

Using the 2024 shipbuilding plan's Alternative 1 as a baseline, the Congressional Budget Office developed three illustrative scenarios to show how the AUKUS pact could affect the size of the Navy's attack submarine force (see the figure).² In the first two scenarios, the Navy would not buy submarines to replace those it sells to Australia, whereas in the third scenario it would.

In Scenario 1, the United States would sell 3 Virginia class SSNs—2 used and 1 new ship—to Australia in the 2030s. The used ships would have roughly 20 years of remaining service life, so they would probably come from the recently completed or soon-to-be-completed group of submarines known as Block IV. The new SSN would be the first ship completed from the group of submarines the Navy plans to order between 2030 and 2036, known as Block VII. In Scenario 2, the United States would sell 5 attack submarines to Australia between 2032 and 2044—2 used ships from Block IV and 3 new ones from Block VII. Under Alternative 1 in the Navy's current shipbuilding plan, the SSN force would consistently number 50 or more ships by 2034 and would grow to 60 by 2053. In

1. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2024* (March 2023), p. 4 and p. 15 (footnote 3), <https://tinyurl.com/37bkemd9> (PDF).

2. The most detailed discussion to date on the specific numbers and types of submarines that Australia would purchase can be found in testimony by senior Australian admirals before a parliamentary hearing on AUKUS. See John Hunter Farrell, “Australia to Get One New Build Virginia Class Submarine, Two From U.S. Navy,” *The Drive* (June 8, 2023), <https://tinyurl.com/33n6nmtj>. See also, Ronald O'Rourke, *Navy Virginia-Class Submarine Program and AUKUS Submarine Proposal: Background and Issues for Congress*, Report RL32418, version 259 (Congressional Research Service, October 23, 2023), pp. 11–20, <https://tinyurl.com/vbhy77ax>.

Box 1.

Continued

The Potential Effect of the AUKUS Security Pact on the U.S. Navy's Inventory of Attack Submarines

Scenarios 1 and 2, reflecting the AUKUS pact, the Navy would have 3 to 5 fewer SSNs during most of the 2033–2053 period.

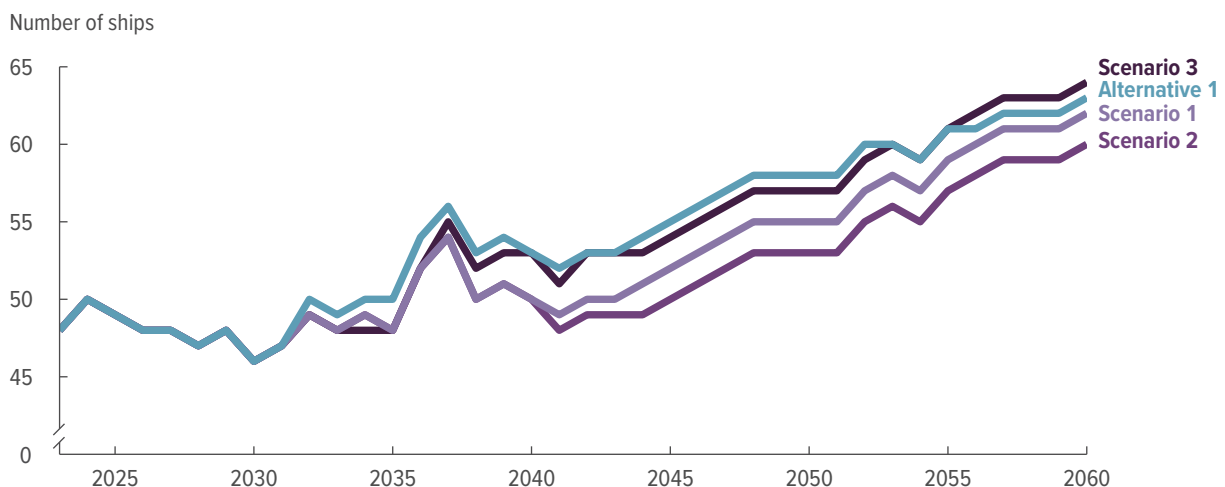
In Scenario 3, the United States would sell 5 SSNs to Australia—2 used and 3 new ships—but the Navy would buy 4 submarines in the 2030s as replacements, effectively increasing production of SSNs to 2 ships per year during that decade. In that case, the Navy would still have fewer attack submarines than it would under Alternative 1 for 20 years (between 2032 and 2052), but more than it would in the other two scenarios. By 2056, however, the Navy would have a slightly larger force of SSNs in Scenario 3 than it would under Alternative 1 of the 2024 plan. (Buying replacement submarines under Alternatives 2 and 3 would be more challenging because of their higher baseline production rates. In those cases, attack submarine production would exceed 2 SSNs per year for several years.)

CBO developed those scenarios under the assumption that Australia would purchase the smaller Virginia class SSNs instead of the larger ships with Virginia payload modules (VPMs), which add four large-diameter payload tubes to ships in that class. Under that assumption, the first two scenarios

represent the minimum and maximum potential capability, respectively, that Australia could acquire from the United States under the AUKUS pact, considering the time required to build new submarines. For example, the United States could not sell and deliver 5 new Virginia class SSNs to Australia in the 2030s unless Australia wanted the larger submarines with VPMs.

Would China be less deterred if the United States reduced the number of its attack submarines to help Australia develop its submarine force? Because the United States and Australia have a strong alliance, improving the Australian Navy's capability could help offset the U.S. Navy's potential loss of capability. That loss might even be more than offset because the Australian submarines would be based in the Western Pacific region and therefore could respond more quickly to any conflict with China involving Taiwan or other issues in the South China Sea. However, Australia would control its own submarines, and their participation in any particular conflict would not be guaranteed. In fact, in March 2020, the Australian defense minister stated that his country did not promise to support the United States in the event of a conflict involving Taiwan and the People's Republic of China.

U.S. Attack Submarine Force Under AUKUS



Data source: Congressional Budget Office. See www.cbo.gov/publication/59508#data.

In Scenario 1, the United States would sell a total of 3 SSNs to Australia: 2 used SSNs (from the Block IV production line) in 2032 and 2035 and 1 new SSN (from the Block VII production line) in 2038.

In Scenario 2, the United States would sell a total of 5 SSNs to Australia: 2 used SSNs (from the Block IV production line) in 2032 and 2035 and 3 new SSNs (from the Block VII production line) in 2038, 2041, and 2044.

In Scenario 3, the United States would sell a total of 5 SSNs to Australia: 2 used SSNs (from the Block IV production line) in 2032 and 2035 and 3 new SSNs (from the Block VII production line) in 2038, 2041, and 2044. Additionally, the Navy would build 4 replacement SSNs in 2030, 2031, 2033, and 2035. The number of replacement submarines built in the 2030s is limited to 4 ships so that a construction rate of 2 SSNs per year is not exceeded. If the Navy could build more than 2 SSNs per year in the 2030s, then its attack submarine force could be larger by the late 2030s.

SSNs = attack submarines.

The Navy's plan provides little information about the size and capabilities of the large payload submarine. CBO's and the Navy's estimates reflect the expectation that the ship would be based on the Columbia class hull with its missile tube section reconfigured to perform various missions and that other sections of the ship would receive the necessary equipment and modifications to support the payloads the submarine might carry. The Navy estimates that each ship would cost, on average, \$7.7 billion under Alternative 1, \$7.6 billion under Alternative 2, and \$7.7 billion under Alternative 3 (see Table 8). CBO estimates they would each cost, on average, \$9.3 billion under Alternative 1, \$8.8 billion under Alternative 2, and \$9.0 billion under Alternative 3.

Attack Submarines. The alternatives in the 2024 shipbuilding plan take substantially different approaches to the future of the attack submarine force. Under Alternatives 1 and 3, the Navy would continue to buy Virginia class ships with VPMs through 2029, resume production of Virginia class ships without VPMs in 2030, purchase the first new SSN(X) in 2035, and then, as in the 2023 plan, put that ship into serial production in 2037.³⁴ Overall, under Alternative 1, the Navy would buy 11 Virginia class ships with VPMs, 10 Virginia class ships without VPMs, and 33 SSN(X)s. With more money to spend under Alternative 3, the service would purchase 11 Virginia class submarines with VPMs, 12 Virginia class ships without VPMs, and then 35 SSN(X)s. The Navy would buy both types of submarines at roughly the rate of 2 per year over the next three decades.

By contrast, Alternative 2 represents the largest and most challenging program for constructing attack submarines: The Navy would buy 11 Virginia class ships with VPMs, 37 Virginia class ships without VPMs, and 18 SSN(X)s—about half the number of next-generation submarines that would be purchased under the other alternatives. The service would buy submarines mostly at a rate of 2 per year, although it would sometimes buy 3 per year. Under Alternative 2, Virginia class ships would remain in production through 2053, and the Navy would purchase 10 to 14 more attack submarines than under the other alternatives (see Figure 9).

34. Under all three alternatives, the Navy would buy a submarine that specializes in subsea and seabed warfare. It would be roughly the size of a Virginia class ship with a VPM but would not carry missile tubes. It would have other capabilities and, once commissioned, would replace the USS *Jimmy Carter* (SSN-23), which currently specializes in that mission.

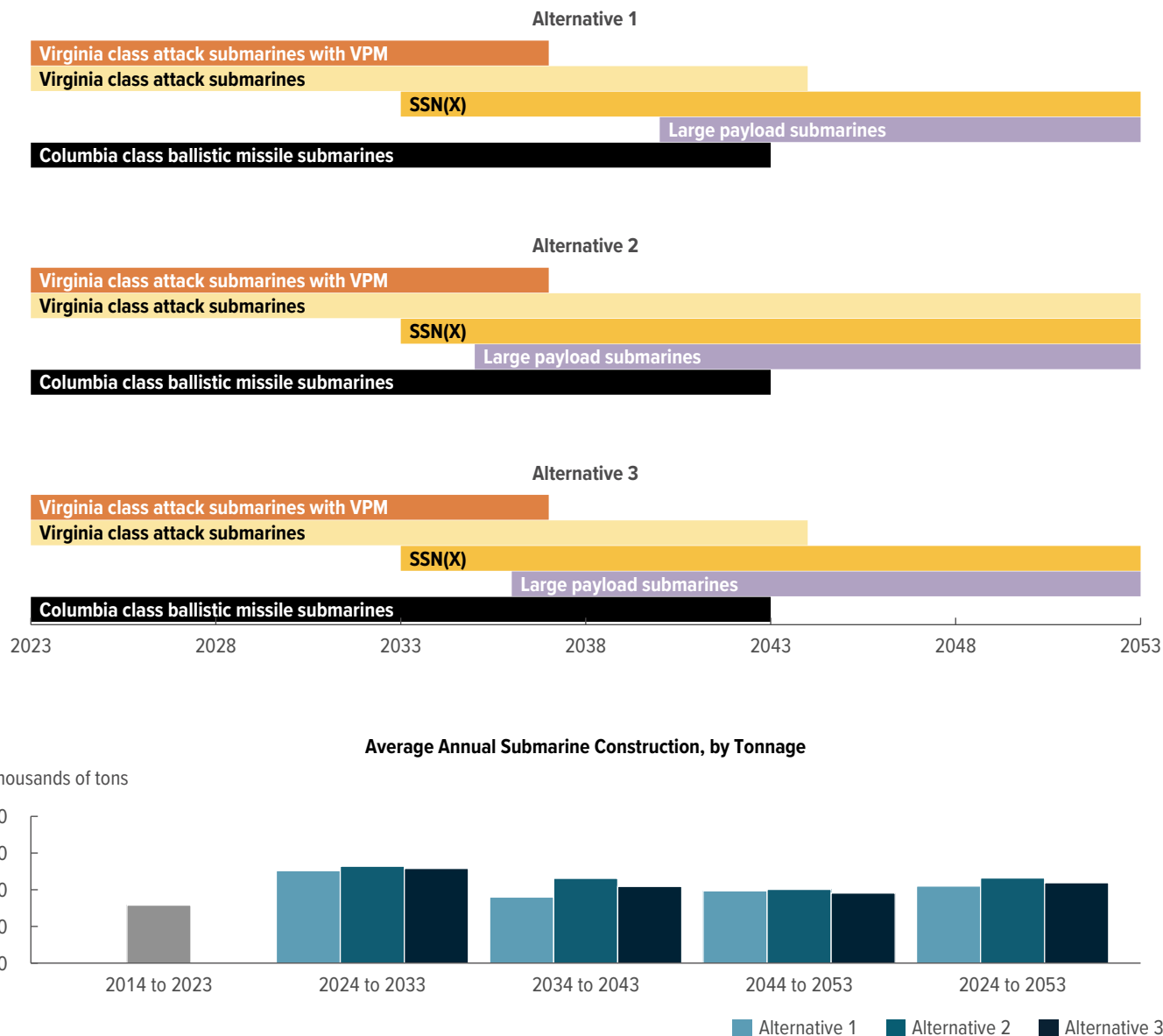
Largely because of conditions in the submarine shipyards, CBO's and the Navy's cost estimates for Virginia class ships with VPMs increased substantially compared with such estimates for the 2023 plan. The Navy estimates that each of those ships would cost \$3.9 billion under Alternative 1 and \$4.0 billion under Alternatives 2 and 3. And for each alternative, the Navy estimates that Virginia class ships without VPMs would cost the same as those with VPMs, even though the former are about 23 percent smaller. That inconsistency suggests that in the Navy's plan, either submarines with VPMs are underpriced or those without VPMs are overpriced. CBO estimates that under all three alternatives, Virginia class ships with VPMs would each cost \$4.3 billion—which is higher than the Navy estimates. CBO's estimates for those ships without VPMs are slightly higher than the Navy's: \$4.0 billion under Alternative 3 and \$4.1 billion under Alternatives 1 and 2.

Estimating the costs of the SSN(X) is difficult because the Navy has not yet determined its capabilities or size. In the past, the Navy has indicated that like the Seawolf class submarine, the next-generation attack submarine should be faster, stealthier, and able to carry more torpedoes than Virginia class ships. The service has also indicated that it wants the SSN(X) to have vertical launch capability, an attribute of the Improved Los Angeles class submarine and the original Virginia class submarine. CBO's cost estimates therefore reflect the assumption that the SSN(X) would be similar to a Seawolf submarine but would have an entirely new design. The submarine's advanced features would make it as quiet and stealthy as possible; it could launch missiles from missile cells and would contain a torpedo room the size of those on Seawolf submarines.

As a result, CBO estimated the size of the SSN(X) to be 10,100 tons of displacement when fully submerged—about 11 percent larger than a Seawolf class ship. The agency estimated the amount of the increase by comparing the displacements of the original Los Angeles class submarine and the Virginia class submarine. In that example, the combined effect of a new generation of submarine technology and a vertical missile capability caused an 11 percent increase in displacement for the Virginia class ships compared with the Los Angeles class. Another way of estimating the size of the SSN(X) is to compare the change in displacement between the Ohio class SSBN and the Columbia class SSBN. The new generation of submarine technology included on the

Figure 9.

Submarine Classes in Production, by Time Period, and Submarine Construction, by Tonnage, Under the Navy's 2024 Plan



Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/59508#data.

For new classes of ships, CBO marks the beginning of production with the appropriation of advanced procurement funding, which typically occurs two years before the lead ship (the first ship of the class) is authorized by the Congress. Advanced procurement funding is used for items with long lead times, such as the ship's nuclear propulsion plant.

The tonnage calculation is based on the estimated Condition A-1 weight for all classes of submarines, which is analogous to the measure of lightship displacement for surface ships.

SSN(X) = next-generation attack submarine; VPM = Virginia payload module.

latter increased its displacement by about 21 percent.³⁵ CBO used the smaller estimate (11 percent) because it is based on displacements of attack submarines rather than ballistic missile submarines.

On the basis of that analysis, CBO estimates that the average cost of each SSN(X) would range from \$7.7 billion to \$8.0 billion under the Navy's three alternatives. The Navy estimates that each SSN(X) would cost \$6.7 billion to \$7.0 billion in all three cases. (Those averages include the lead ship, which costs considerably more than subsequent submarines in the class.) Both the Navy's and CBO's estimates for the SSN(X) have increased substantially compared with those for last year's shipbuilding plan. The current estimates reflect the same higher costs in the submarine industry that are behind the increased estimates for Virginia class ships. The range in CBO's estimates reflects the different construction schedules for the SSN(X) in the Navy's plan. Under Alternatives 1 and 3, the SSN(X) would be built in similar quantities and mostly at a rate of 2 ships per year from 2037 to 2053. Under Alternative 2, however, only half as many SSN(X)s would be built, resulting in less savings from the learning effect and less cost reduction for the program over the 30-year period.

Large Surface Combatants

The alternatives in the Navy's 2024 plan call for the purchase of the same types of destroyers in nearly the same quantities and on the same schedules as the alternatives in the 2023 plan. Currently, the Navy's fleet includes 73 DDG-51 destroyers consisting of four variants designated as Flight I, Flight II, Flight IIA, and Flight III. Additionally, 3 Flight IIAs and 16 Flight IIIs (an upgraded design) are being built or have been authorized for construction by the Congress. Under Alternatives 1 and 3, the service would purchase 18 more DDG-51 Flight IIIs by 2033; under Alternative 2, it would buy 20 more of those ships, intermittently produced through 2039. In all three cases, construction of

the next-generation destroyer, designated as DDG(X), would commence in 2032.

DDG-51 Flight III Destroyers. To improve future ballistic missile defense capabilities beyond those provided by existing DDG-51s, the Navy modified the design of the DDG-51 Flight IIA destroyer to create the Flight III configuration. That modification incorporates the new Air and Missile Defense Radar (AMDR, also known as SPY-6), which is larger and, according to testing, nearly 100 times more powerful than the radar on current DDG-51s.³⁶ For the AMDR to operate effectively in the new Flight III configuration, however, the ships must also have a greater capacity to generate electrical power and cool major systems.³⁷

CBO estimates that with those improvements incorporated into the Flight III's design, and with the associated increases in its displacement, the average cost of each ship, under any of the alternatives in the 2024 plan, would be \$2.2 billion—slightly more than the Navy's estimate of \$2.1 billion under Alternatives 1 and 3 or the same as its estimate under Alternative 2.

DDG(X) Next-Generation Destroyers. According to the 2024 plan, production of the next-generation class of destroyer would start in 2032, two years later than envisioned in the 2023 plan. The Navy would buy 38 ships under Alternative 1, 30 under Alternative 2, and 46 under Alternative 3. Under Alternatives 1 and 3, it would buy 1 ship per year for several years and then increase to 2 ships per year for most years through 2053. (The Navy would occasionally buy 1 ship per year under Alternative 1 and occasionally 3 ships per year under Alternative 3.) Under Alternative 2, however, purchases would proceed more slowly; the Navy would buy 1 ship per year until 2039 (except for 2034, when it would buy none) and would then alternate between 1 and 2 ships per year through 2053.

35. In a personal communication, Ronald O'Rourke, naval affairs analyst with the Congressional Research Service, suggested comparing displacements of Ohio class and Columbia class ships as an additional way to estimate the size of the SSN(X). To compare displacements of Ohio class and Columbia class submarines, CBO adjusted its calculations to account for the fact that an Ohio class ship carries 24 sea-launched ballistic missiles, whereas a Columbia class ship carries 16 of them.

36. Jason Sherman, "Navy Determines SPY-6 Radar Three Times Stronger Than Original Requirement," *Inside Defense* (May 3, 2019), <https://tinyurl.com/y4zyghq7>.

37. See Ronald O'Rourke, *Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress*, Report RL33745, version 248 (Congressional Research Service, August 28, 2023), <https://go.usa.gov/xSKzG>, and *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, Report RL32109, version 268 (Congressional Research Service, August 8, 2023), <https://go.usa.gov/xSKzU>.

The Navy estimates that the average cost of the DDG(X) would vary from \$2.4 billion per year under Alternative 3 to \$2.5 billion per year under Alternatives 1 and 2. Those estimates are about the same as the corresponding estimates in the Navy's 2023 shipbuilding plan, after adjusting for inflation.

According to Navy officials, the new DDG(X)'s combat capabilities would be equivalent or superior to those of the DDG-51 Flight III; it would also have a larger hull, substantially more power, more stealth characteristics, and a greater capacity to accommodate the installation of new weapon systems and other capabilities in the future.³⁸ The Navy has indicated that the initial design prescribes a displacement of 13,500 tons. If that is the case, then the Navy's estimates imply that the DDG(X) would cost about 14 percent more than the DDG-51 Flight III but would have a full-load displacement that is 40 percent greater.

Such an outcome, however, seems unlikely given the history of the Zumwalt class DDG-1000 guided missile destroyer. In the 2000s, the Navy estimated that those ships would cost only slightly more than the DDG-51s that were then in production, even though the DDG-1000 was about 50 percent larger. Ultimately, costs for the DDG-1000 were about 45 percent higher than anticipated (see Figure 10).³⁹ However, the Navy contends that the case of the DDG(X) will differ from that of the DDG-1000 because the former ship would have a combat system and radar substantially like those of the DDG-51 Flight III and would only require designing a new hull and new power and cooling systems. By contrast, the DDG-1000 included new technology affecting every major aspect of the ship's design—its hull, power system, radar, and weapons, among other things.⁴⁰

Given the estimated size of the DDG(X) and its use of new technology, CBO estimates that its average cost would range from \$3.2 billion to \$3.5 billion under the Navy's three alternatives (or from 37 percent to 39 percent more than the Navy's estimates). To fund the DDG(X) program from 2024 to 2053, the Navy would need \$130 billion under Alternative 1, \$106 billion under Alternative 2, and \$149 billion under Alternative 3, CBO estimates. The uncertainty about the ultimate size and capabilities of the next-generation destroyer suggests that its final cost could differ substantially from both the Navy's and CBO's estimates.

Small Surface Combatants

The Navy would purchase a similar number of small surface combatants under all three alternatives: 53 under Alternative 1, 56 under Alternative 2, and 58 under Alternative 3. The major difference between them is that under Alternatives 1 and 3, the Navy would buy 16 FFG-62 Constellation class guided missile frigates, the type of frigate that is currently being built for the service, whereas it would buy only 10 such ships under Alternative 2. The Navy would then begin purchasing an upgraded version of the FFG-62, called the Flight II, starting in 2035 under Alternative 1, in 2029 under Alternative 2, and in 2033 under Alternative 3.

The Flight II designation for that follow-on ship in the 2024 plan suggests that it would be roughly the same size as the FFG-62, displacing about 7,300 tons and equipped with upgraded combat and weapon systems. The Navy's estimated average cost for the FFG-62 (for both Flights I and II) under all 3 alternatives is about \$1.0 billion per ship. CBO estimates that both types of ships would cost \$1.2 billion, on average.⁴¹

38. Ronald O'Rourke, *Navy DDG(X) Next-Generation Destroyer Program: Background and Issues for Congress*, Report IF11679, version 34 (Congressional Research Service, August 3, 2023), <https://go.usa.gov/xSKSR>.

39. Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2020 Shipbuilding Plan* (October 2019), www.cbo.gov/publication/55685.

40. In the 1980s, the Navy sought to build a lower-cost surface combatant, the DDG-51, by reusing the combat systems and propulsion train of the CG-47 cruiser while building a smaller

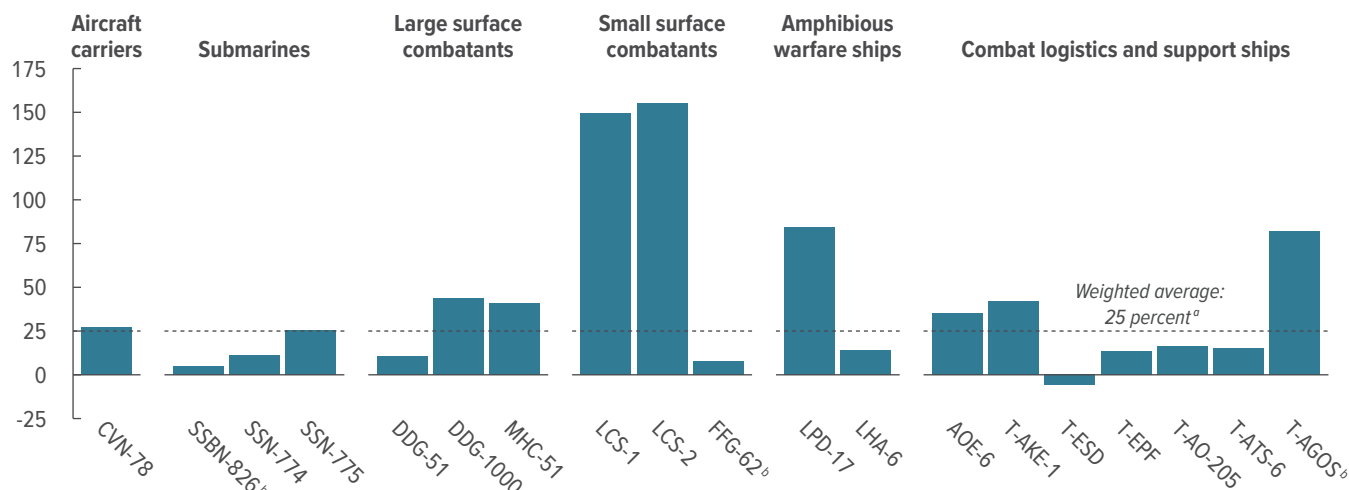
ship. Using that technique, the Navy was successful in building a less expensive ship, but the cost-to-weight ratio of the lead ships was roughly the same. Similarly, the cost-to-weight ratio of the last 11 cruisers was about the same as that of the 12 destroyers built after the lead ship.

41. For a discussion of the differences between the Navy's and CBO's estimates of the costs of the FFG-62 class program, see Congressional Budget Office, *The Cost of the Navy's New Frigate* (October 2020), www.cbo.gov/publication/56669.

Figure 10.

Cost Growth in Lead Ships, 1985 to 2024

Percent



Data source: Congressional Budget Office, using data from the Department of the Navy. See www.cbo.gov/publication/59508#data.

The lead ship is the first ship of its class. For most ships, CBO calculated cost growth using the first and last mentions of a ship in the books that accompany each year's budget: *Justification of Estimates, Shipbuilding and Conversion, Navy*. For AOE-6, MHC-51, T-EPF, and DDG-51, CBO relied on information papers provided by the Navy for the final estimates and on the *Budget Appendixes* for the years those ships were authorized.

AOE = fast combat support ship; CVN = nuclear-powered aircraft carrier; DDG = guided missile destroyer; FFG = guided missile frigate; LCS = littoral combat ship; LHA = amphibious assault ship; LPD = amphibious transport dock; MHC = coastal mine hunter; SSBN = ballistic missile submarine; SSN = attack submarine; T-AGOS = ocean surveillance ship; T-AKE = dry cargo ship; T-AO = oiler; T-ATS = towing, salvage, and rescue ship; T-EPF = expeditionary fast transport; T-ESD = expeditionary transfer dock.

a. CBO calculated the weighted average by adding the initial costs for all ships in the data set and comparing the result with the sum of all final costs of the ships in the data set. For ships still in the early phase of construction, their weight in the average was adjusted by the percentage of the ship that was complete. The unweighted average cost growth is 40 percent.

b. These ships are still in an early phase of construction.

Amphibious Warfare Ships

The Navy is preparing its new force structure assessment, in which it will reevaluate the size and composition of the amphibious warfare force. In the meantime, both the Chief of Naval Operations' *Navigation Plan 2022* and testimony during hearings on the Department of the Navy's budget by the Marine Corps Commandant called for a force of 31 large and midsize amphibious warfare ships, the size of the current force.⁴² Those ships are composed of LHA and LHD amphibious assault ships, LPD

amphibious transport docks, and LSD dock landing ships. However, the Navy would maintain a force of fewer than 31 such ships under any of the alternatives in the 2024 plan. (See Box 2 for a discussion of how the Navy could maintain a force of 31 large and midsize amphibious ships.)

The CNO's report also calls for 18 medium landing ships (designated as light amphibious warships in the report), and the Commandant's testimony calls for 18 to 36 of them; there are none in the current fleet. By 2041, the Navy would have built and would then maintain about 25 LSMs under Alternative 1 and 19 under Alternative 2. Alternative 3 calls for a force of 33 LSMs and would achieve that level in 2045.

42. See Chief of Naval Operations, *Navigation Plan 2022* (July 2022), p. 10, tinyurl.com/waru7vwt (PDF); and Statement of General David H. Berger, Commandant of the Marine Corps, on the Posture of the United States Marine Corps, Before the Senate Appropriations Committee (March 28, 2023), p. 1, <https://tinyurl.com/bdha4j5z> (PDF).

Box 2.

How the Navy Could Maintain the Statutorily Required Force of 31 Large and Midsize Amphibious Warfare Ships

The 2023 National Defense Authorization Act requires the Department of Defense to maintain a force of 31 large and midsize amphibious warfare ships. The midsize ships are amphibious transport docks (LPDs) and dock landing ships (LSDs). The large ships are amphibious assault ships (LHAs or LHDs)—which, by law, should number at least 10. Today's amphibious warfare force of 31 ships includes only 9 amphibious assault ships. (Because of the unfortunate and early loss of the USS *Bonhomme Richard* to a fire in July 2020, the Navy will not have 10 amphibious assault ships until the LHA-8 is commissioned in 2026.)

Moreover, none of the alternatives in the Navy's 2024 shipbuilding plan for the 2024–2053 period would maintain a force of 31 large and midsize amphibious warfare ships, mainly because the service would not purchase enough ships to replace those that reach the end of their service life over the next 30 years. Yet General Eric Smith, Commandant of the Marine Corps, has stated that meeting the statutory requirement for amphibious warfare ships is the service's "top priority."¹ And in *Navigation Plan 2022*, former Chief of Naval Operations Admiral Michael Gilday also endorsed a force of 31 large and midsize amphibious warfare ships.²

Amphibious Assault Ships

The Congressional Budget Office examined two approaches that the Navy could take to maintain 10 amphibious assault

ships (after the LHA-8 is commissioned in 2026) through 2053. First, beginning in 2027 (when the service plans to order the next LHA), the Navy could build 1 LHA every four years and extend the service life of 4 existing LHDs (which is currently 40 years) up to 50 years. The Navy has said that the optimal strategy for acquiring LHAs is to build one every four years. Second, the Navy could build 1 LHA every three years and add a total of 21 years of service life to 3 LHDs, extending their age up to 50 years.

The Navy is just beginning to assess the cost of extending the service life of LHDs for 10 years. That would involve, at a minimum, putting those ships into a drydock to conduct potentially extensive work on major items, such as refurbishing ballast tanks and upgrading hull, mechanical, and electrical systems. Although the Navy has not estimated the cost of that work, historical data suggest it could easily exceed \$500 million per ship—which does not include the annual costs of crewing and operating ships.

Midsize Amphibious Ships

Maintaining a force of 31 large and midsize amphibious warfare ships would also require the Navy to build 1 LPD every two years beginning in 2025. The existing force of LPD-17s and most LSDs would also need to have a service life of about 40 years. Under those circumstances, and in concert with the changes regarding amphibious assault ships, the Navy could maintain 31 or more large and midsize amphibious warfare ships for 28 of the next 30 years (see the figure).

Effects on the Shipbuilding Budget

The Navy's 2024 shipbuilding plan provides three alternative long-range projections of its future fleet. Maintaining the statutorily required force of amphibious warfare ships would increase costs beyond those included in the Navy's or CBO's

Continued

CBO's and the Navy's cost estimates for amphibious assault ships vary depending on the alternative. The Navy would buy 6 LHAs at a rate of 1 ship every four or five years under Alternative 1; 5 LHAs at intervals of five, six, and eight years under Alternative 2; and 4 LHAs at a rate of 1 ship every three or four years through 2038 under

Alternative 3. The Navy estimates that each ship would cost, on average, \$4.3 billion under Alternatives 1 and 2 and \$4.1 billion under Alternative 3. By contrast, CBO estimates that they each would cost, on average, \$4.7 billion under Alternative 1, \$4.8 billion under Alternative 2, and \$4.4 billion under Alternative 3.

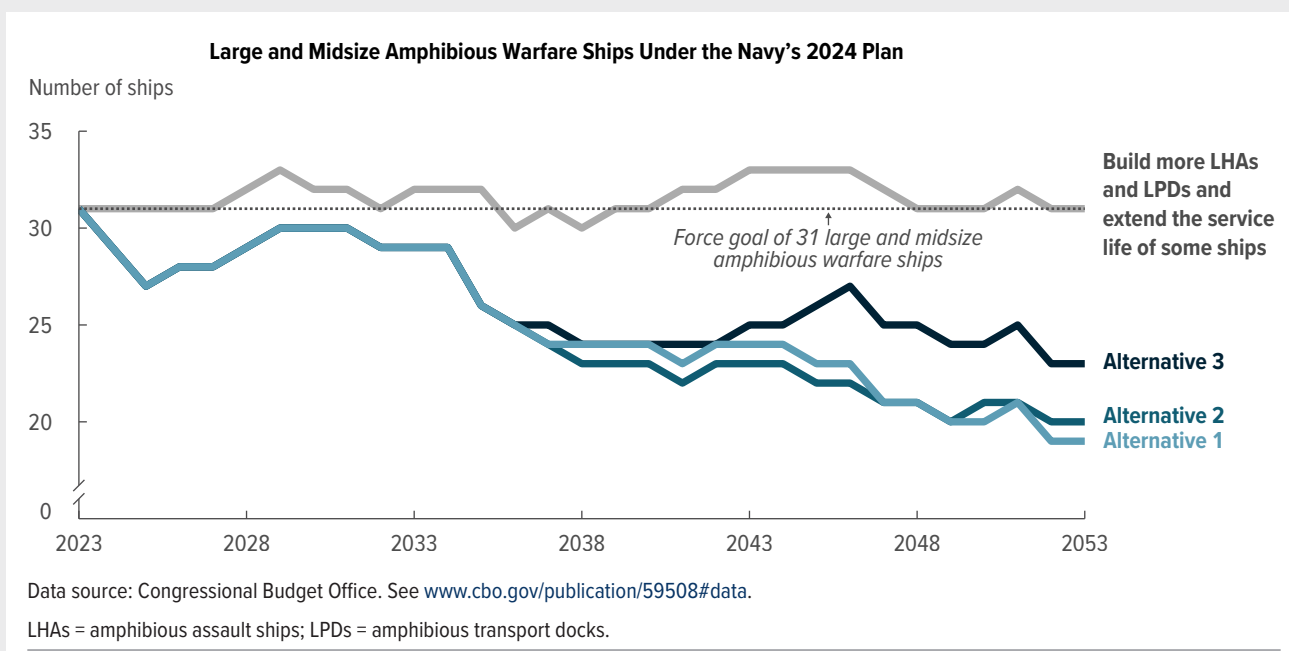
Box 2.

Continued

How the Navy Could Maintain the Statutorily Required Force of 31 Large and Midsize Amphibious Warfare Ships

cost estimates for the plan's alternatives. Compared with Alternative 1, for example, building an LHA every three years and an LPD every two years would add about \$36 billion to the cost of new-ship construction over the 2024–2053 period (or an average of \$0.9 billion per year). Building an LHA every four years and an LPD every two years would add about \$27 billion (or an average \$1.2 billion per year) to such costs over that period. The additional costs under Alternatives 2 and 3 would

be slightly higher because in those cases the Navy would buy fewer LHAs than under Alternative 1. CBO did not independently assess the extra costs of extending the service life of the necessary number of amphibious ships. Operating and personnel costs would also be higher because the Navy would be operating and maintaining a larger number of ships than under the alternatives in the 2024 plan.

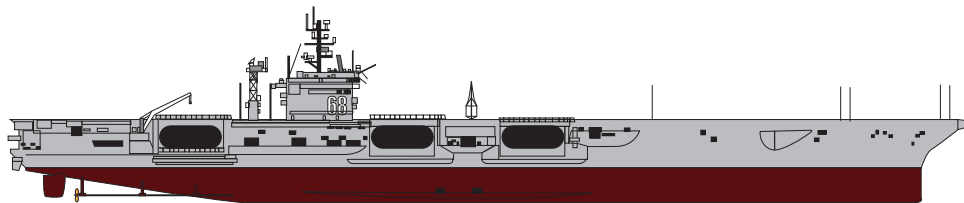


The Navy's and CBO's cost estimates for LPD(X)s, which are replacements for the service's LPD-17 class ships, are more closely aligned than they were in CBO's analysis of the 2023 shipbuilding plan. The Navy estimates that LPD(X)s would cost \$2.2 billion to \$2.3 billion per ship; CBO estimates that the cost would range between \$2.5 billion and \$2.7 billion per ship. Most of the difference lies in the fact that CBO's constant-dollar

estimates account for historically observed real growth in the costs of labor and materials in the shipbuilding industry, whereas the Navy's estimates do not. Because the Navy would begin to purchase those replacement ships in the mid-2030s under Alternative 3, and in the 2040s under Alternatives 1 and 2, the effect of that real growth, which compounds over time, would be significant.

Appendix: Major Types of Ships in the Navy's Fleet

Aircraft Carriers



Nimitz Class CVN-68

The Navy's 11 aircraft carriers are the heart of the battle force. Each carries an air wing of about 60 aircraft, which can attack hundreds of targets per day (based on 12 hours of flight operations) for up to a month before needing to rest. Carriers are the largest ships in the fleet, with a displacement of about 100,000 tons. (A ship's displacement is the weight of water that it displaces when floating or, for a submarine, when submerged.) Ten of the current carriers belong to the Nimitz class. The Navy commissioned the first of a new class, the *Gerald R. Ford*, in 2017.

Strategic Ballistic Missile Submarines



Ohio Class SSBN-726

Strategic ballistic missile submarines are one component of the U.S. nuclear triad. Each submarine carries up to 20 Trident missiles armed with 1 to 8 nuclear warheads apiece. (Originally, they were built with 24 missile tubes, but arms control treaties now limit them to 20 operational tubes.) The Navy has 14 Ohio class ballistic missile submarines, each of which displaces about 19,000 tons when submerged. The service has 4 other submarines of that class that it converted to a conventional guided missile (SSGN) configuration. Those SSGNs carry up to 154 Tomahawk missiles as well as special operations forces.

Attack Submarines

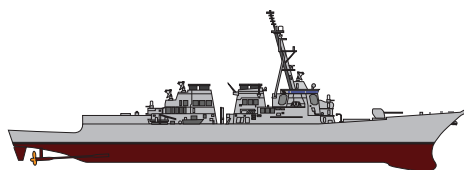


Virginia Class SSN-774

Attack submarines are the Navy's premier undersea warfare and antisubmarine weapons. Since the end of the Cold War, however, they have mainly been used for covert intelligence gathering. They can also launch Tomahawk missiles at land targets, frequently in the early stages of a conflict in an effort to destroy enemy air defense systems. Of the Navy's 48 attack submarines, 21 belong to the Virginia class, 3 to the Seawolf class, and 24 to the Los Angeles class. Their displacement is less than half that of ballistic missile submarines.



Large Surface Combatants



Arleigh Burke Class DDG-51 Destroyer

Large surface combatants, which include cruisers and destroyers, are the workhorses of the fleet. They provide ballistic missile defense for the fleet and for overseas regions. They defend aircraft carriers and amphibious warfare ships against other surface ships, aircraft, and submarines, and they perform such day-to-day missions as patrolling sea lanes, providing an overseas presence, and conducting exercises with allies. They can also launch Tomahawk missiles to strike land targets. Most of the Navy's surface combatants displace about 9,000 to 10,000 tons.

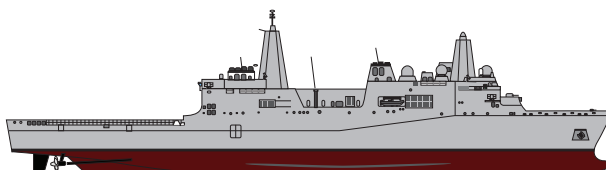
Small Surface Combatants



Freedom Class LCS-1 Littoral Combat Ship

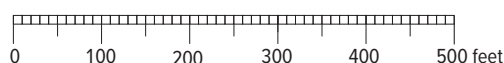
Small surface combatants include littoral combat ships (LCSs) and frigates. LCSs, which are built in two variants, are intended to counter mines, small boats, and diesel-electric submarines in the world's coastal regions. The Navy's new frigates, which it began building in 2020, are designed to be multimission ships, capable of performing many of the missions of the LCS but also carrying robust antiship capabilities as well as being able to defend against threats in the immediate area. More routinely, LCSs and frigates—like their counterparts, the large surface combatants—patrol sea lanes, provide an overseas presence, and conduct exercises with allies. They range in size from 3,000 to 7,000 tons. The Navy currently has no frigates because it retired all of its Oliver Hazard Perry frigates as of 2015.

Amphibious Warfare Ships

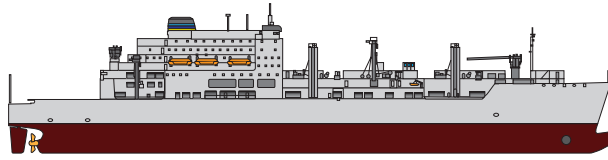


San Antonio Class LPD-17

The Navy has five classes of amphibious warfare ships. The two classes referred to as amphibious assault ships (also known as large-deck amphibious ships or helicopter carriers) are the second-largest types of combat ships in the fleet, displacing between 40,000 and 45,000 tons. With capacity for about half the troops and equipment of a Marine expeditionary unit, the amphibious assault ship is the centerpiece of the amphibious ready group. In addition to troops, each ship can carry as many as 30 helicopters and 6 fixed-wing Harrier jump jets or short takeoff and landing versions of the Joint Strike Fighters (F-35Bs), or up to 20 of those fixed-wing aircraft. The other three classes are divided into two types: amphibious transport docks and dock landing ships. Two of those ships together provide the remaining transport capacity for a Marine expeditionary unit in an amphibious ready group. They range in size from 16,000 to 25,000 tons.

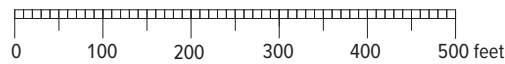


Combat Logistics and Support Ships



Lewis and Clark Class T-AKE-1

The many combat logistics and support ships in the Navy's fleet provide the means to resupply, repair, salvage, or tow combat ships. The most prominent of those vessels are fast combat support ships, which resupply carrier strike groups with fuel, dry cargo (such as food), and ammunition. Logistics and support ships can be as small as 2,300 tons for an oceangoing tug or as large as 90,000 tons for an expeditionary sea base.



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About This Document

This report was prepared as required by the National Defense Authorization Act for Fiscal Year 2012 (Public Law 112-81). In keeping with the Congressional Budget Office's mandate to provide objective, impartial analysis, the report makes no recommendations.

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CBO seeks feedback to make its work as useful as possible. Please send comments to communications@cbo.gov.

A handwritten signature in black ink, appearing to read "Phillip Swagel", with a long, sweeping horizontal line extending to the right.

Phillip L. Swagel
Director
October 2023