Congressional Budget Office

Testimony

An Analysis of the Navy's Fiscal Year 2014 Shipbuilding Plan

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Notes

Unless otherwise indicated, all dollar amounts in this study are in 2013 dollars, and all years are federal fiscal years (which run from October to September).

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

Chairman Forbes, Ranking Member McIntyre, and Members of the Subcommittee, thank you for the opportunity to testify on the Navy's 2014 shipbuilding plan and 2012 force structure assessment. My submitted statement today reprises the Congressional Budget Office's (CBO's) recently released report *An Analysis of the Navy's Fiscal Year 2014 Shipbuilding Plan*. That report was required under the 2012 National Defense Authorization Act.

The Navy is required by law to submit each year a report to the Congress that projects the service's inventory goals, procurement plans, and cost estimates for its shipbuilding program over the next 30 years. Since 2006, CBO has been performing an independent analysis of the Navy's latest shipbuilding plan. The CBO report on which I am testifying today examines the implications of the Navy's 2014 plan and its ability to meet inventory goals through 2043. The report also provides independent estimates of the cost of the Navy's shipbuilding program and compares those cost estimates to the levels of funding that the Navy is likely to receive.

According to its most recent 30-year plan, the Navy envisions buying a total of 266 ships over 30 years at an average annual cost of about $17 billion for new construction alone and roughly $19 billion for total shipbuilding (which includes new-ship construction, refueling of nuclear-powered aircraft carriers, and other costs related to shipbuilding). By comparison, CBO's estimates of the costs of the Navy's plan are $2.5 billion more—an average of $19 billion per year for new construction and $21 billion per year for total shipbuilding. Those amounts are significantly higher than the amounts the Navy has received annually for shipbuilding over the last 30 years.

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An Analysis of the Navy's Fiscal Year 2014 Shipbuilding Plan

Summary

At the direction of the Congress, the Department of Defense (DoD) generally issues annual reports that describe its plan for building new ships over the next 30 years. DoD submitted its 2014 shipbuilding plan to the Congress in May 2013, covering fiscal years 2014 to 2043.[1] The 2014 plan reflects the Navy's most recent goals for battle force ships—goals that were developed in 2012 and outlined in a report to the Congress in January 2013; that analysis is hereafter referred to as the 2012 force structure assessment.[2] The goals developed in 2012 were slightly different from the ones that were outlined in the 2005 force structure assessment and were reflected in the Navy's shipbuilding plans up through last year.[3]

The 2013 and 2014 shipbuilding plans are very similar, but not identical, with respect to the Navy's total inventory goal (in military parlance, its requirement) for battle force ships, the number and types of ships the Navy would purchase over 30 years, and the proposed funding to implement the plans. The Congressional Budget Office (CBO) examined the 2014 plan in detail and estimated the costs of the proposed ship purchases using its own estimating methods and assumptions. CBO also analyzed how those ship purchases would affect the Navy's inventories of various types of ships over the next three decades.

The total costs of carrying out the 2014 plan—an average of about $21 billion in 2013 dollars per year over the next 30 years—would be one-third higher than the funding amounts that the Navy has received in recent decades but slightly less than the costs of the 2013 plan, CBO estimates.

Inventory Goals

The Navy's 2014 shipbuilding plan states that the service's goal for its inventory of battle force ships is 306 ships. That goal reflects the Navy's 2012 force structure assessment and is slightly smaller than the goal of 310 to 316 ships specified in the 2013 plan and the goal of 313 ships that resulted from the 2005 force structure assessment. However, the goal of 306 ships is greater than the Navy's current number of ships; at the end of 2013, the Navy's battle force fleet will consist of 285 ships.

1. The 2014 shipbuilding plan is Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY 2014* (May 2013), http://tinyurl.com/mwrgdn3 (PDF; 3.3 MB).

2. Department of the Navy, *Report to Congress: Navy Combatant Vessel Force Structure Requirement* (January 2013), http://tinyurl.com/kvhspjs. Although the report was released in early 2013, the force structure assessment was conducted in 2012. Battle force ships comprise aircraft carriers, submarines, surface combatants, amphibious warfare ships, and combat logistics and some support ships.

3. In February 2006, the Navy presented a long-term shipbuilding plan that called for expanding the battle force fleet from the then-current size of 285 ships to 313 ships by 2020. A few months later, CBO issued a study analyzing that plan and estimating its potential costs. In every year that the Navy has issued its shipbuilding plan since then, CBO has performed an independent analysis of that plan. See Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2007* (February 2006) and Congressional Budget Office, *Options for the Navy's Future Fleet* (May 2006), www.cbo.gov/publication/17802. See also Statement of J. Michael Gilmore, Assistant Director, and Eric J. Labs, Principal Analyst, before the Subcommittee on Projection Forces of the Committee on Armed Services, U.S. House of Representatives, *Potential Costs of the Navy's 2006 Shipbuilding Plan* (March 30, 2006), www.cbo.gov/publication/17679.

Table 1.

Comparison of the Navy's 2013 and 2014 Shipbuilding Plans

	2013 Plan (2013–2042)	2014 Plan (2014–2043)	Change from 2013 to 2014
		Number of Ships Purchased Over 30 Years	
Combat Ships			
Aircraft carriers	6	6	0
Ballistic missile submarines	12	12	0
Attack submarines	46	47	1
Destroyers	70	70	0
Littoral combat ships	70	66 [a]	-4
Amphibious warfare ships	18	19	1
Subtotal	222	220	-2
Combat Logistics and Support Ships	46	46	0
Total	**268**	**266**	**-2**
		Costs of New-Ship Construction[b] (Billions of 2013 dollars)	
Total Cost Over 30 Years			
Navy's estimate	520	504	-16
CBO's estimate	617	580	-37
Average Annual Cost			
Navy's estimate	17.3	16.8	-0.5
CBO's estimate	20.6	19.3	-1.3
Average Cost per Ship			
Navy's estimate	1.9	1.9	0
CBO's estimate	2.3	2.2	-0.1

Source: Congressional Budget Office based on data from the Department of the Navy.

a. Under the 2014 plan, the Navy will have 52 littoral combat ships in service after 2029. However, because those ships are expected to be in service for 25 years each, the Navy will begin buying replacements in 2030.

b. Costs of new-ship construction exclude funds for refueling nuclear-powered aircraft carriers. They also exclude funds for ship conversions, construction of ships that are not part of the Navy's battle force (such as oceanographic survey ships), training ships, outfitting and postdelivery costs (which include the purchase of many smaller tools and pieces of equipment that are needed to operate a ship but are not necessarily provided by the manufacturing shipyard as part of ship construction), and smaller items. Costs for the mission packages for littoral combat ships, which are not funded in the Navy's shipbuilding accounts, also are not included.

The Navy's shipbuilding plan would fall short of meeting the service's inventory goals for some types of ships. For example, the plan would fail to meet the goal of 88 large surface combatants (destroyers and cruisers) in 2030 and beyond. Moreover, the Navy assumes in its plan that most of its destroyers will serve for 40 years, even though the Navy's large surface combatants have typically served for 30 years or less. If the current destroyers serve for only 35 or 30 years, the shortfall in large surface combatants would be more than twice as large as projected in the Navy's plan.

Purchasing Plan

Under the 2014 plan, the Navy would buy a total of 266 ships over the 2014–2043 period: 220 combat ships and 46 combat logistics and support ships (see the top panel of Table 1). Given the rate at which the Navy plans to retire ships from the fleet, that construction plan would not achieve a fleet equal to the inventory goal of 306 ships until 2037. The 2013 shipbuilding plan called for the purchase of 2 more ships over 30 years, but because the Navy's inventory goal was 4 to 10 ships higher in 2013, that year's plan would have fallen even further short of the goal.

Costs

The Navy estimates that buying the new ships as specified in the 2014 plan would cost $504 billion over 30 years, or an average of $16.8 billion per year (see the bottom panel of Table 1). (Unless otherwise indicated, all dollar amounts in this report reflect budget authority in 2013 dollars.) Those figures are solely for the construction of new ships—the only type of costs reported in the Navy's 30-year shipbuilding plans. Other activities typically funded from the Navy's budget accounts for ship construction—such as refueling nuclear-powered aircraft carriers and outfitting new ships with various small pieces of equipment after the ships have been built and delivered—would, in CBO's estimation, add $1.9 billion to the Navy's average annual shipbuilding costs under the 2014 plan. (Between 2009 and 2013, the cost of those other activities averaged $1.9 billion per year.) Including those extra costs, the average cost of the Navy's 2014 plan is $18.7 billion per year, slightly less than the cost of the 2013 plan.

Using its own models and assumptions, CBO estimates that the cost of new-ship construction in the Navy's 2014 plan would total $580 billion over 30 years, or an average of $19.3 billion per year. Generally, CBO estimates the cost of a future ship on the basis of the relationship between the weight and cost of analogous ships. The resulting figure is then adjusted for factors such as the number of ships of the same type being built at a given shipyard; production efficiencies that occur as more ships of the same class are produced simultaneously; and the fact that the costs of labor and materials have generally risen faster in the shipbuilding industry than in the economy as a whole, which generates growth in the inflation-adjusted cost of a given ship over time. Including the costs of refueling aircraft carriers and other items, such as outfitting new ships, raises the overall average cost of the Navy's plan to $21.2 billion per year, CBO estimates. That figure is slightly less than CBO's estimate of the average annual cost of the Navy's 2013 plan.

CBO's estimate of the cost of new-ship construction in the Navy's 2014 shipbuilding plan is $76 billion, or 15 percent, higher than the Navy's estimate. Specifically, CBO's estimate is 6 percent higher than the Navy's for the first 10 years of the plan, 14 percent higher for the following decade, and 26 percent higher for the final 10 years. Two factors explain most of the differences between the two estimates. First, the Navy and CBO used different estimating methods and assumptions regarding the designs and capabilities of future ships. Second, the Navy, in contrast with CBO, does not appear to have accounted for the fact that costs of labor and materials have traditionally grown faster in the shipbuilding industry than in the economy as a whole; that difference produces a widening gap between the two estimates over time.

Costs of the Plan Compared with Historical Funding

If the Navy receives the same amount of funding (in constant dollars) for new-ship construction in each of the next 30 years that it has on average over the past three decades, it will not be able to afford all of the purchases in the 2014 plan.[4] CBO's estimate of $19.3 billion per year for new-ship construction in the Navy's 2014 shipbuilding plan is 38 percent above the historical average funding of $14.0 billion (see Figure 1). And CBO's estimate of $21.2 billion per year for the full cost of the plan is 34 percent higher than the $15.8 billion the Navy has spent on average per year for all items in its shipbuilding accounts over the past 30 years.

The Effect of the Budget Control Act of 2011 on Navy Ship Programs

The Navy's 2014 shipbuilding plan, like its 2013 plan, does not address the caps on defense funding from 2014 to 2021 that stem from the Budget Control Act of 2011 (BCA) as amended by the American Taxpayer Relief Act of 2012. Because this report provides CBO's analysis of the costs of the Navy's plan, it also does not incorporate those caps.

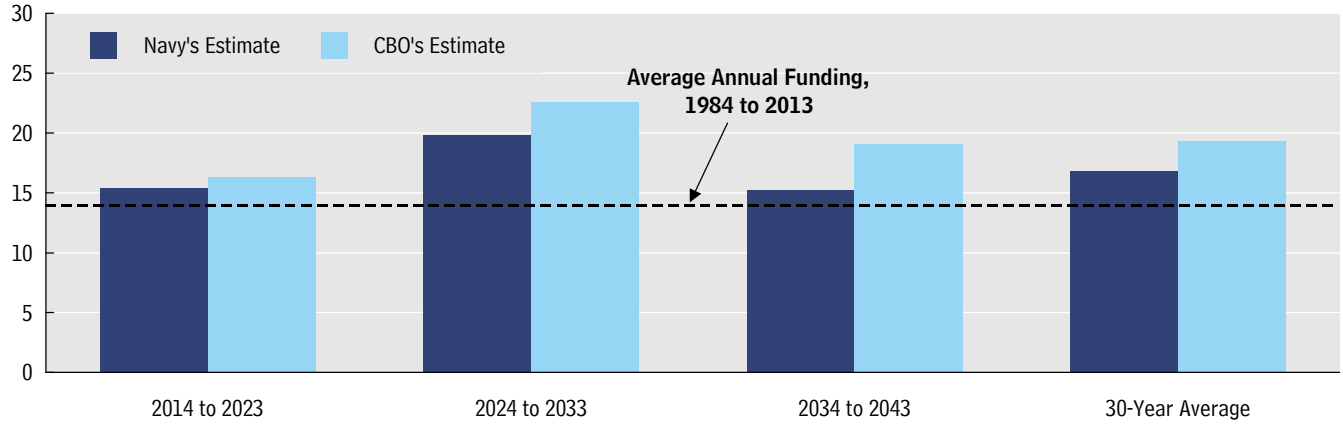
If the BCA is left in place, however, it will probably have three effects on the Navy's shipbuilding plan. First, the sequestration of appropriated funds in 2013 required the Navy to slow or alter elements of its shipbuilding programs that were under way. So far, however, the Navy has not canceled any ship purchases because of insufficient funding. Second, the Congress provided authority and some funding to purchase a third destroyer in 2013, one more than in the Navy's 2013 request. The BCA's funding caps may prevent the purchase of that ship if the

4. For a broader discussion of historical cost trends in Navy shipbuilding, see the statement of Eric J. Labs, Senior Analyst for Naval Forces and Weapons, Congressional Budget Office, before the Subcommittee on Seapower and Expeditionary Forces of the House Committee on Armed Services, *The Long-Term Outlook for the U.S. Navy's Fleet* (January 20, 2010), www.cbo.gov/publication/41886.

Figure 1.

Average Annual Costs of New-Ship Construction Under the Navy's 2014 Plan

(Billions of 2013 dollars)



Source: Congressional Budget Office based on data from the Department of the Navy.

Note: Costs of new-ship construction exclude funds for refueling existing nuclear-powered aircraft carriers. They also exclude funds for ship conversions, construction of ships that are not part of the Navy's battle force (such as oceanographic survey ships), training ships, outfitting and postdelivery costs (which include the purchase of many smaller tools and pieces of equipment needed to operate a ship but not necessarily provided by the manufacturing shipyard as part of ship construction), and smaller items. Costs for the mission packages for littoral combat ships, which are not funded in the Navy's shipbuilding accounts, also are not included.

Navy is unable to secure additional funding for it in 2014. Third, funding for new-ship construction will probably be well below the amounts required for the 2014 shipbuilding plan, unless such funding is protected at the expense of funding for other military activities. Specifically, if the Navy receives the same percentage of DoD's budget during the coming decade and devotes the same percentage of its budget to ship construction as it has historically, the shipbuilding budget would be 30 percent below CBO's estimate of the amount required by the Navy's 2014 shipbuilding plan.

Changes in Inventory Goals Under the 2014 Plan

The Navy's 2014 shipbuilding plan was submitted to the Congress by the Secretary of Defense on May 10, 2013. That plan reflects the Navy's new goal of 306 battle force ships—a goal that was first described in a report by the Navy to the Congress in January 2013 and was based on the Navy's 2012 force structure assessment.[5] That goal replaced the 313-ship goal developed in the 2005 force assessment plan and the goal of 310 to 316 ships specified in the 2013 shipbuilding plan. (Box 1 discusses the major ships in the Navy's fleet and the roles they play.)

The changes in the Navy's inventory goals from the 2013 plan are as follows:

- The number of ballistic missile submarines was changed from a range of 12–14 to 12 (see Table 2).
- The number of guided missile submarines was changed from a range of zero–4 to zero.
- The number of large surface combatants was lowered from approximately 90 to 88.
- The number of small surface combatants and mine countermeasures ships was reduced from approximately 55 to 52.
- The number of amphibious warfare ships was increased from approximately 32 to 33.

Taken together, those changes amount to a reduction in the overall inventory goal of 4 to 10 ships for the battle force fleet, lowering the previous goal of 310 to 316 ships to 306 ships.

5. Department of the Navy, *Report to Congress: Navy Combatant Vessel Force Structure Requirement* (January 2013).

Box 1.

The Roles of Major Types of Ships in the Navy's Battle Force Fleet

Nimitz Class
Aircraft Carrier

The Navy's 10 **aircraft carriers** are the heart of the battle force fleet. Each carries an air wing of about 60 aircraft, which can attack hundreds of targets per day for up to a month before needing to be rested. Carriers are by far the largest ships in the fleet, with a weight (displacement) of about 100,000 tons. All 10 current carriers belong to the Nimitz class.

Ohio Class Ballistic
Missile Submarine

Strategic **ballistic missile submarines** carry one of the major parts of the U.S. nuclear deterrent, up to 24 Trident missiles with one to eight nuclear warheads apiece. The Navy has 14 Ohio class ballistic missile submarines in that strategic role. In addition, the Navy has converted 4 submarines of that class to a conventional guided missile (SSGN) configuration, each of which displaces about 19,000 tons when submerged. Those SSGNs carry up to 154 Tomahawk missiles as well as special-operations forces.

Los Angeles Class
Attack Submarine

Attack submarines are the Navy's premier undersea warfare and antisubmarine weapon. Since the end of the Cold War, however, they have mainly performed covert intelligence-gathering missions. They have also been used to launch Tomahawk missiles at inland targets in the early stages of conflicts. The Navy has 55 attack submarines, 42 of which belong to the Los Angeles class. At 7,000 tons, they are less than half the size of ballistic missile submarines.

Arleigh Burke Class
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 regional areas overseas. They defend the Navy's aircraft carriers and amphibious warfare ships against other surface ships, aircraft, and submarines. They also perform many day-to-day missions, such as patrolling sea lanes, providing an overseas presence, and conducting exercises with allies. In addition, they are capable of striking land targets with Tomahawk missiles. Most of the Navy's surface combatants displace about 9,000 to 10,000 tons.

Freedom Class
Littoral Combat Ship

Small surface combatants include frigates and littoral combat ships. Frigates today are used to perform many of the same day-to-day missions as large surface combatants. Littoral combat ships are intended to counter mines, small boats, and diesel electric submarines in the world's coastal regions. More routinely, they will also patrol sea lanes, provide an overseas presence, and conduct exercises with allies. They range in size from 3,000 to 4,000 tons.

Wasp Class Amphibious
Assault Ship

Austin Class Amphibious
Transport Dock

The Navy has six classes of **amphibious warfare ships**. Two classes, referred to as **amphibious assault ships** (also known as large-deck amphibious ships or helicopter carriers), are the second-largest ships in the fleet at 40,000 tons. They form the centerpiece of amphibious ready groups, and each can carry about half the troops and equipment of a Marine expeditionary unit. They also carry as many as 30 helicopters and 6 fixed-wing Harrier jump jets, or up to 20 Harriers. The other four 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.

Supply Class Fast Combat
Support Ship

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 operate with carrier strike groups to resupply them with fuel, dry cargo (such as food), and ammunition. Logistics and support ships can be as small as 2,000 tons for an oceangoing tug or as large as 50,000 tons for a fully loaded fast combat support ship.

Source: Congressional Budget Office.

Note: Ship silhouettes are not to scale.

Table 2.

The Navy's Evolving Goals for Its Force Structure

	Goals for a 313-Ship Fleet in the Navy's 2005 Force Structure Assessment	Goals Implied in the Navy's 2013 Shipbuilding Plan	Goals for a 306-Ship Fleet in the Navy's 2012 Force Structure Assessment
Aircraft Carriers	11	11	11
Submarines			
Ballistic missile	14	12 to 14	12
Attack	48	~48	48
Guided missile	4	0 to 4	0
Large Surface Combatants			
Destroyers	69	~90	88
Cruisers	19	0	0
Small Surface Combatants and Mine Countermeasures Ships[a]	55	~55	52
Amphibious Warfare Ships	31	~32	33
MPF(F) Ships	12	0	0
Combat Logistics Ships	30	~29	29
Support Ships			
Joint high-speed vessels	3	10	10
Other[b]	17	~23	23
Total	**313**	**310 to 316** [c]	**306**

Source: Congressional Budget Office based on data from the Department of the Navy.

Note: MPF(F) = Maritime Prepositioning Force (Future); ~ = approximately.

a. Includes littoral combat ships, Oliver Hazard Perry FFG-7 frigates, and Avenger class mine ships.

b. Includes command ships, salvage ships, ocean tugs, ocean surveillance ships, and tenders.

c. The Navy described its total goal in last year's shipbuilding plan as about 300 ships, but the specific numbers included in that plan implied a range of 310 to 316 ships.

This report does not evaluate the validity of the goals identified by the Navy, such as the fleet's ability to fulfill its missions in the national military strategy. Rather, the report assesses the costs of the Navy's 2014 shipbuilding plan, the effects of that plan on the force structure, and the extent to which the plan would satisfy the Navy's goals for major components of the U.S. fleet.

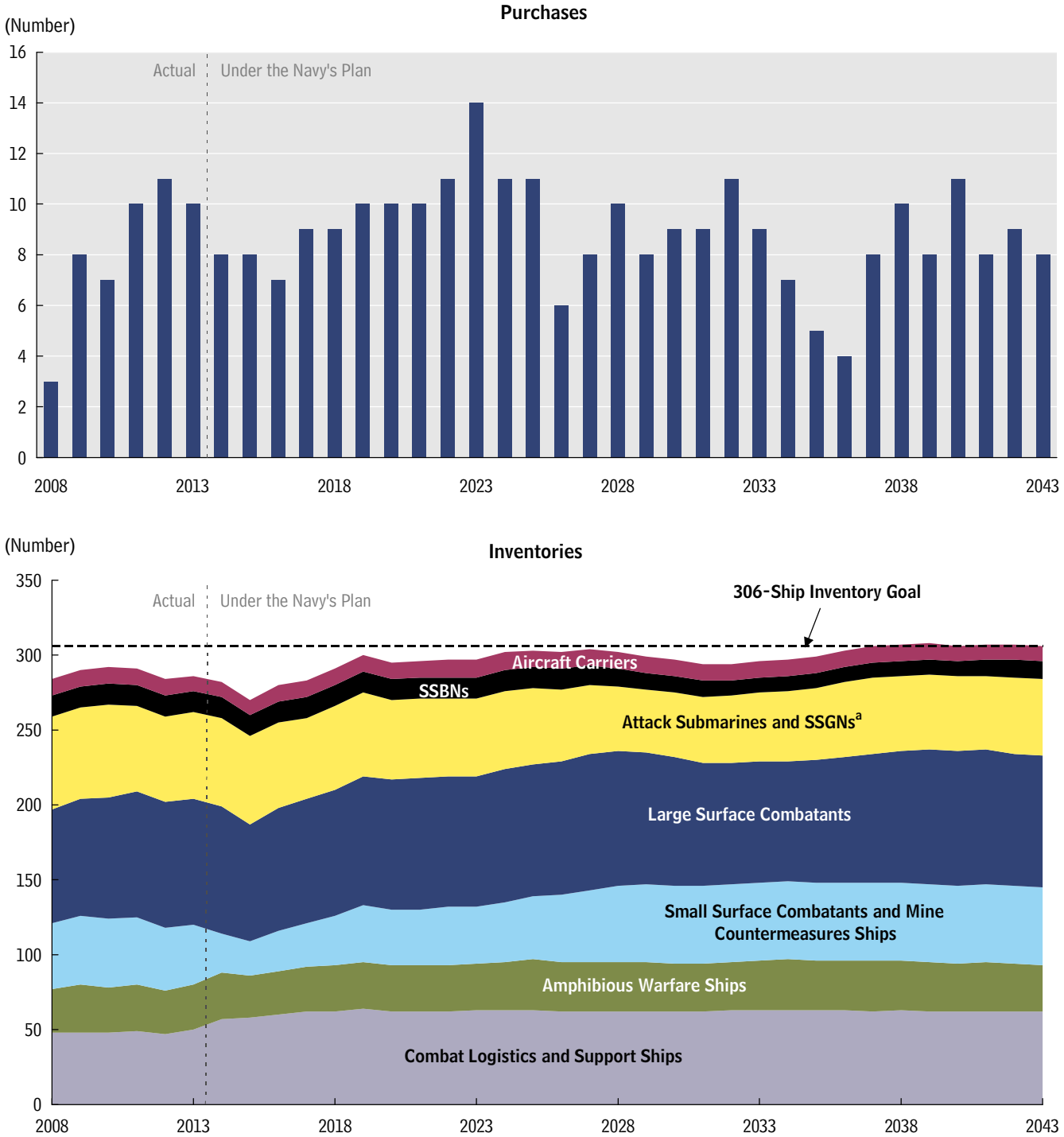
Ship Purchases and Inventories Under the 2014 Plan

The Navy intends to buy 8 ships in 2014 and a total of 41 ships between 2014 and 2018—the period covered by DoD's 2014 Future Years Defense Program (FYDP), which is a five-year funding plan that DoD updates annually (see Figures 2 and 3). Thereafter, the Navy would buy an additional 225 ships through 2043, for a total of 266 ships over 30 years or an average of about 9 per year. The pace of shipbuilding would be slightly faster, on average, in the near term than later on. The Navy plans to purchase an average of about 10 ships annually between 2014 and 2023, a little more than 9 ships per year between 2024 and 2033, and not quite 8 ships per year between 2034 and 2043. If implemented as described above, the 2014 plan would not achieve the intended force of 306 ships until 2037 (see the bottom panel of Figure 2).

Altogether, the Navy would buy 2 fewer ships over 30 years under the 2014 plan than it would have under the 2013 plan. The composition of ship purchases—particularly, the mix of combat ships and logistics and support vessels—is virtually the same under the 2013 and 2014 plans.

Figure 2.

Annual Ship Purchases and Inventories Under the Navy's 2014 Plan



Source: Congressional Budget Office based on data from the Department of the Navy.

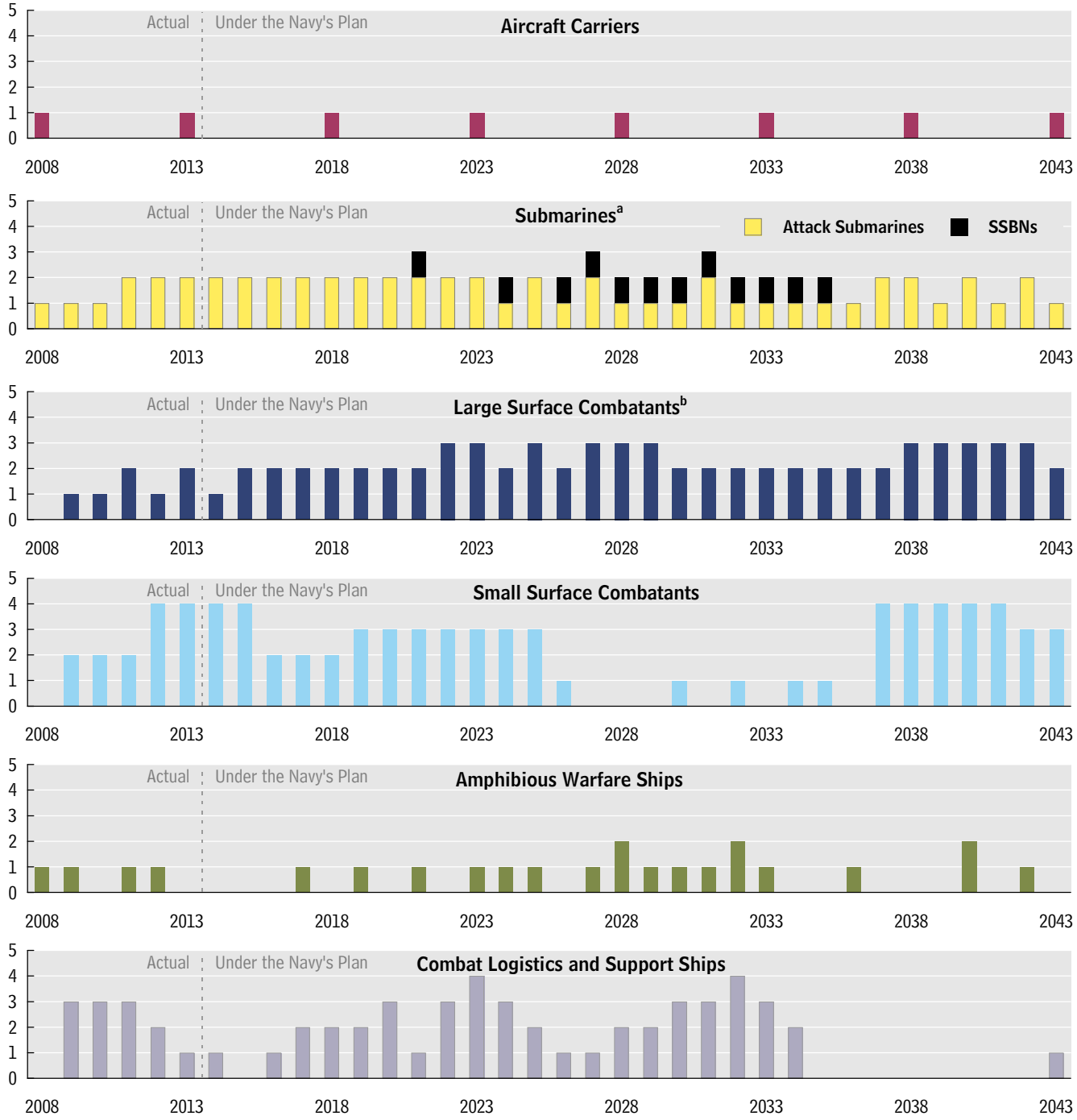
Notes: Small surface combatants and mine countermeasures ships include littoral combat ships, Oliver Hazard Perry FFG-7 frigates, and Avenger class mine ships.

SSBNs = ballistic missile submarines; SSGNs = guided missile submarines.

a. Although the Navy does not plan to build more SSGNs, four will be in service through the mid-2020s.

Figure 3.

Annual Ship Purchases, by Category, Under the Navy's 2014 Plan



Source: Congressional Budget Office based on data from the Department of the Navy.

Note: SSBNs = ballistic missile submarines.

a. Although SSGNs (guided missile submarines) are included in the Navy's inventory, the service does not plan to build more of them.

b. This figure excludes the additional destroyer authorized by Congress in 2013.

Combat Ships

Under the 2014 plan, the Navy envisions buying 220 combat ships—aircraft carriers, submarines, large and small surface combatants, and amphibious warfare ships—between 2014 and 2043. That total is 2 fewer ships than under the 2013 plan. Those purchases would still leave the Navy short of its inventory objectives for ballistic missile and attack submarines, large surface combatants, and amphibious warfare ships for significant parts of the 2014–2043 period. The shortfalls are roughly what they were under the 2013 plan. For aircraft carriers, the Navy would meet or exceed its goal of 11 ships throughout the 2014–2043 time frame, except for brief periods from 2013 to 2016 and 2040 to 2043. For small surface combatants, the Navy plans to replace its frigates and mine countermeasures ships with littoral combat ships; it would not reach its new objective of having 52 such ships in the fleet until 2029, the same year the 2013 plan intended to meet the original goal of 55 ships.

Ballistic Missile Submarines. The 2014 shipbuilding plan calls for buying the first replacement for the Ohio class ballistic missile submarines, also known as the SSBN(X), in 2021 and for purchasing 12 SSBN(X)s in total (see Figure 3); those boats would begin to enter the fleet in 2030. (The Navy estimates that the lead submarine will take 7 to 8 years to build and that an additional year or more will be needed to complete testing before it is ready for at-sea operations.) However, the retirement of Ohio class submarines as they reach the end of their 42-year service life means that the Navy's inventory of ballistic missile submarines (SSBNs) would fall below the stated goal of 12 by 1 or 2 submarines between 2029 and 2041 (see Figure 4). In particular, between 2032 and 2040, the Navy would have 10 SSBNs.

Attack Submarines. Under the 2014 plan, the Navy would purchase 47 attack submarines (SSNs) through 2043, which would not be enough to keep that force up to the stated goal of 48 throughout the next 30 years. The number of attack submarines would decline from 48 in 2024 to a low of 42 in 2029 and then increase to about 50 after 2035. (The Navy will be able to meet the goal of 48 SSNs for 3 more years over the next 30 than assumed in last year's plan because the Congress approved—by providing advance procurement funding in 2013—the planned purchase of an additional submarine in 2014.) The reason for the decline in the number of attack submarines after 2024 is that, in 2014, the Navy expects to begin retiring Los Angeles class attack submarines (SSN-688s), which were generally built at rates of 3 or 4 per year during the 1970s and 1980s, as they reach the end of their service life. The Navy would replace those submarines with Virginia class attack submarines (SSN-774s) and their successors at rates of generally 1 or 2 per year.

Large Surface Combatants. The 2014 shipbuilding plan calls for buying 70 destroyers based on the existing Arleigh Burke class destroyer (DDG-51) design (see Table 1 on page 2). Those purchases would allow the Navy's inventory of large surface combatants to meet the goal of 88 ships for 13 years over the next 30. Specifically, the number of such ships would meet the goal in 2021 and for six years in the mid-2020s, but then would fall to a low of 80 in 2034 before increasing to 88 or more by 2038. As with the attack submarine force, the number of large surface combatants would decline as the Navy began retiring the remainder of its Ticonderoga class cruisers (CG-47s) in the 2020s (after retiring 7 cruisers in 2015) and DDG-51s in the late 2020s at a faster pace than their replacements would be commissioned.[6]

The assumptions about the service life of large surface combatants remain the same under the 2014 plan as under the 2013 plan. The 2013 plan assumed that all 34 Arleigh Burke class destroyers commissioned after 2000 would have a service life of 40 years, and that the 28 destroyers of that class that were commissioned in 2000 and earlier would remain in the fleet for 35 years. Historically, very few cruisers or destroyers have served in the fleet longer than 30 years.[7]

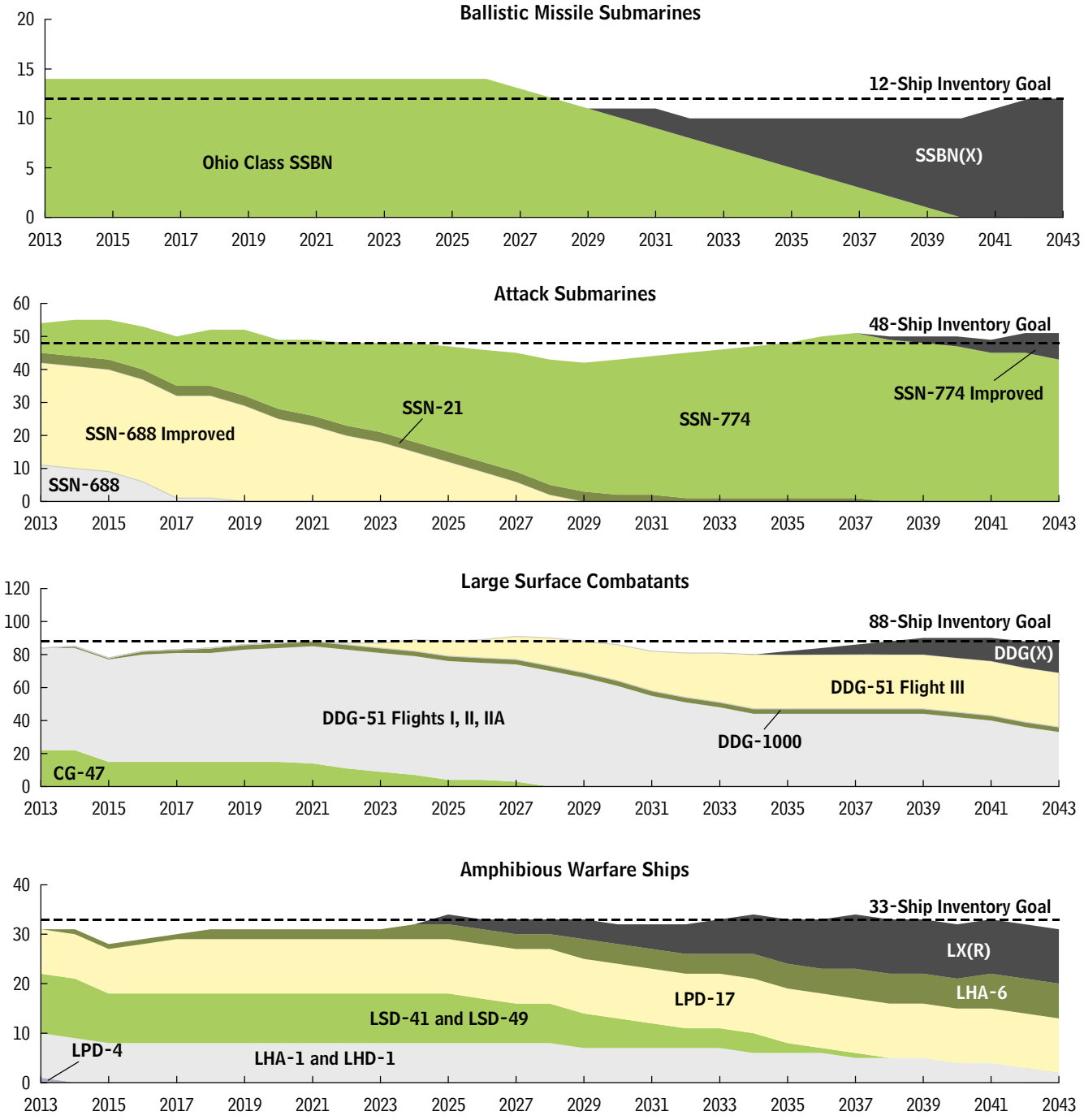
Amphibious Warfare Ships. The current shipbuilding plan calls for buying 19 amphibious warfare ships through 2043, which would increase the amphibious force from 31 ships today to the current goal of 33 by 2025. The force would stay at that size or greater through

6. Under the 2013 plan, the Navy proposed retiring those 7 cruisers in 2013 and 2014. The Congress, however, wanted the Navy to keep the cruisers for a longer period and provided an additional $2.4 billion for that purpose in the National Defense Authorization Act for Fiscal Year 2013, creating a special account called the Ship Modernization, Operation and Sustainment Fund (SMOSF). That fund is scheduled to expire at the end of 2014, and, assuming no further funding is provided, the Navy would retire those 7 ships in 2015.

7. See Congressional Budget Office, *Resource Implications of the Navy's Fiscal Year 2009 Shipbuilding Plan* (June 9, 2008), p. 25, www.cbo.gov/publication/41703.

Figure 4.

Annual Inventories Versus Goals for Selected Categories of Ships Under the Navy's 2014 Plan



Source: Congressional Budget Office.

Notes: SSBN = ballistic missile submarine; SSN = attack submarine; DDG = guided missile destroyer; CG = guided missile cruiser; LSD = dock landing ship; LHA and LHD = amphibious assault ship; LPD = amphibious transport dock; LX(R) = amphibious ship replacement.

2043—except for 2030 to 2032, when the force would fall to 32 ships, and 2040, 2042, and 2043, when the force would have 32, 32, and 31 ships, respectively. The Navy assumes that it would keep its LHD class amphibious assault ships in the fleet for 43 to 45 years, the same as in the 2013 plan but longer than in some earlier plans.

Combat Logistics and Support Ships

In its 2014 plan, the Navy envisions buying 46 combat logistics and support ships in the next three decades—the same as in the 2013 plan. Combat logistics ships include T-AKE dry cargo ships, T-AO oilers, and AOE fast combat support ships; they operate with or directly resupply combat ships that are on deployment. Those planned purchases include 17 new oilers (which provide fuel and a few other supplies to ships at sea) at a rate of 1 per year through the 2020s; that program would conclude in 2033. The plan also includes the purchase of 1 replacement T-AKE dry cargo and ammunition ship in 2043.

Support ship purchases in the Navy's plan include 10 joint high speed vessels (JHSVs), 4 salvage ships, 5 surveillance ships, 2 tenders, 4 fleet tugs, 2 command ships to replace ones in the existing fleet that will retire over the next 30 years, and 1 new afloat forward staging base, a variant of the Navy's mobile landing platform ships.[8]

The only significant change from the Navy's 2013 plan in this category is the decision to retire 2 of the existing AOEs in 2014 and 2015; the 2013 plan would have retired those ships in 2033 and 2034. The Navy now plans to retire those ships early because of a determination in the 2012 force structure assessment that 2 fewer combat logistics ships would be needed in the future. The AOEs were chosen because they are more expensive to operate than other Navy logistics ships that can perform the same missions.

Shipbuilding Costs Under the 2014 Plan

According to the Navy's estimates, carrying out its planned purchases of new ships would cost an average of $16.8 billion per year through 2043—3 percent less than the $17.3 billion average under its 2013 plan (in 2013 dollars). In making its estimates, the Navy divided the time frame of the 2014 plan into three periods: the near term (2014 to 2023), the midterm (2024 to 2033), and the far term (2034 to 2043). CBO also estimated the costs of the Navy's 2014 plan; to price the Navy's ships, it used its own cost models and assumptions, which are explained in detail later in this report. Overall, CBO's estimates are $2.5 billion per year, or 15 percent, higher than the Navy's, but the differences are smaller for the near term, larger for the midterm, and much larger for the far term (see Figure 5). Including other items that the Navy would need to fund from its budget accounts for ship construction would raise both the Navy's estimates and CBO's estimates by about $2 billion per year, leaving CBO's estimates of that full cost 13 percent above the Navy's corresponding figures.[9]

The Navy's Estimates

The Navy's 2014 report offers a frank discussion of the difficulties in estimating the capabilities that the Navy will want ships to have—and thus the cost of those ships—over the three planning periods. For the near term, the report explained, "the projections in the period are based on our most accurate understanding of required combat capabilities, future defense budget toplines, and shipbuilding costs based on actual procurements in progress. The cost estimates for this period are the most accurate of the three planning periods." For the midterm, "the accuracy of cost estimates diminishes in this time frame." And for the far term, "since the strategic environment and state of technology 20–30 years hence are both sure to be much different than they are today, the precision and accuracy of the ship types and cost projections in this period are much more speculative."[10]

New-Ship Construction Costs. According to this year's plan, in the near term, building new ships will cost an average of $15.4 billion per year (see the top row of Table 3). That number excludes $1.4 billion in cost overruns for ships that were funded before 2014 but that will

8. The afloat forward staging base is a ship designed to remain on station overseas for long periods of time, providing support to other naval forces, such as special operations units, patrol craft, or minesweepers.

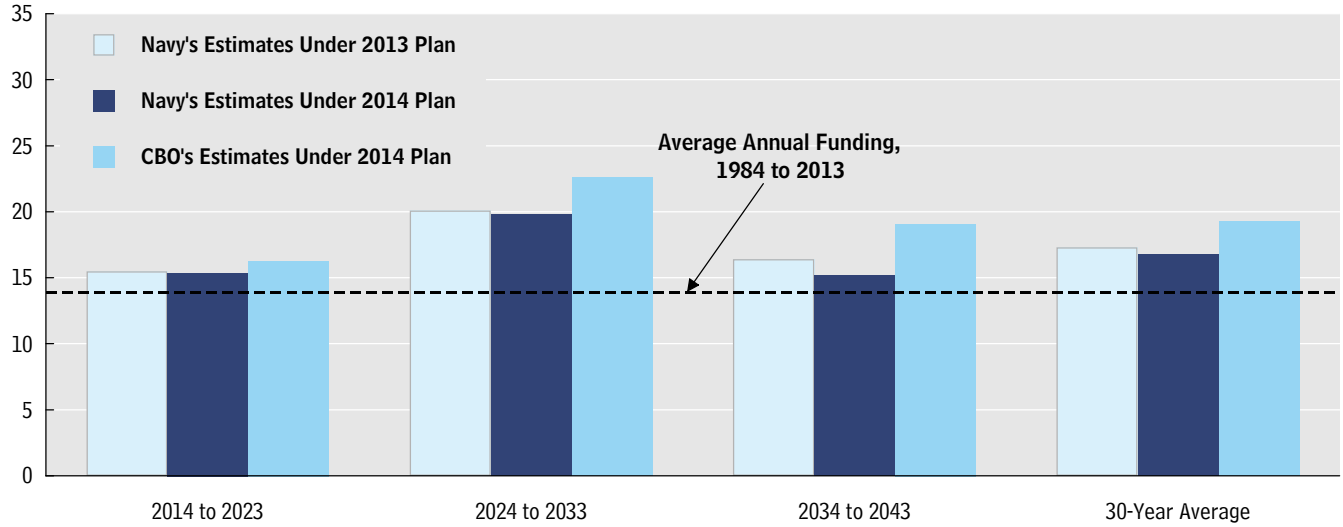
9. The Navy funds shipbuilding through two accounts: Ship Construction, Navy (commonly called the SCN account); and the National Defense Sealift Fund, which includes, among other things, funding for the procurement of some types of logistics ships.

10. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY 2014* (May 2013), pp. 12–13.

Figure 5.

Average Annual Costs of New-Ship Construction Under the Navy's 2013 and 2014 Plans

(Billions of 2013 dollars)



Source: Congressional Budget Office based on data from the Department of the Navy.

Note: Costs of new-ship construction exclude funds for refueling nuclear-powered aircraft carriers. They also exclude funds for ship conversions, construction of ships that are not part of the Navy's battle force (such as oceanographic survey ships), training ships, outfitting and postdelivery costs (which include the purchase of many smaller tools and pieces of equipment that are needed to operate a ship but are not necessarily provided by the manufacturing shipyard as part of ship construction), and smaller items. Costs for the mission packages for littoral combat ships, which are not funded in the Navy's shipbuilding accounts, also are not included.

require additional funds to be paid out in 2014 and 2015. In the midterm, replacing the Navy's current Ohio class ballistic missile submarines drives up the average cost of new-ship construction to $19.8 billion per year. According to the Navy's estimates, building the SSBN(X) will cost $5.5 billion per year in the middle decade of their plan. In the far term, the Navy's estimated costs fall to an average of $15.2 billion.

Although the Navy's shipbuilding plan suggests that the midterm will be its most challenging fiscal period, the latter half of the near term (2019 to 2023) would require shipbuilding budgets that are almost as large as the middle decade. According to the Navy's estimates, the average budget for new-ship construction rises from $12.7 billion per year for the 2014–2018 period to $18.2 billion per year for the 2019–2023 period and then to $19.8 billion per year for the following decade (see Figure 6).

Total Shipbuilding Costs. As in previous shipbuilding plans, the Navy's latest estimates exclude other costs that it would have to pay out of its budget accounts for ship construction. Specifically:

- Costs of refueling nuclear-powered aircraft carriers, whose reactors are replaced midway through the ships' service lives;[11] and
- Other costs, such as those for ship conversions, construction of ships that are not part of the Navy's battle force (such as oceanographic survey ships), training ships; outfitting and postdelivery costs (which include the purchase of many smaller tools and pieces of equipment that are needed to operate a ship but are not necessarily provided by the shipyard when the ship is built), and smaller items.

Including the costs of refueling carriers, as estimated by CBO, would increase the Navy's estimate for the cost of the 2014 shipbuilding plan by roughly $1 billion per year to an average of $17.8 billion a year through 2043.

11. In 2010, the Navy transferred funding for refueling nuclear-powered submarines to other accounts (Other Procurement, Navy; Operation and Maintenance, Navy; and Weapons Procurement, Navy) that are not used to purchase ships. Thus, CBO did not include the refueling costs for submarines in its estimates of future shipbuilding costs.

Table 3.

Average Annual Shipbuilding Costs Under the Navy's 2014 Plan, by Decade

	Near Term (2014–2023)	Midterm (2024–2033)	Far Term (2034–2043)	Total (2014–2043)
	Navy's Estimates (Billions of 2013 dollars)			
New-Ship Construction	15.4	19.8	15.2	16.8
New-Ship Construction and Refueling of Nuclear-Powered Aircraft Carriers[a]	16.6	20.9	16.0	17.8
New-Ship Construction, Refueling of Nuclear-Powered Aircraft Carriers, and Other Items[b]	17.6	21.8	16.6	18.7
	CBO's Estimates (Billions of 2013 dollars)			
New-Ship Construction	16.3	22.6	19.1	19.3
New-Ship Construction and Refueling of Nuclear-Powered Aircraft Carriers	17.5	23.7	19.9	20.4
New-Ship Construction, Refueling of Nuclear-Powered Aircraft Carriers, and Other Items	18.5	24.5	20.5	21.2
	Percentage Difference Between the Navy's and CBO's Estimates			
New-Ship Construction	6	14	26	15
New-Ship Construction and Refueling of Nuclear-Powered Aircraft Carriers	5	13	24	14
New-Ship Construction, Refueling of Nuclear-Powered Aircraft Carriers, and Other Items	5	13	23	13
Memorandum (Billions of 2013 dollars):				
CBO's Estimate of the Costs of Reaching the Navy's Goal of a Fleet of 306 Ships[c]	18.5	21.2	17.7	19.1
Costs of Mission Packages for Littoral Combat Ships	0.4	0.1	0.3	0.3

Source: Congressional Budget Office based on data from the Department of the Navy.

Note: Other items include construction of non–battle force ships (such as oceanographic survey ships), training ships, outfitting and postdelivery costs (which include the purchase of many smaller tools and pieces of equipment needed to operate a ship but not necessarily provided by the manufacturing shipyard as part of ship construction), and other small items. Actual costs for the Navy's shipbuilding accounts over the past 30 years averaged about $16 billion per year for all items.

a. These numbers represent the Navy's estimate for new-ship construction and CBO's estimate for the refueling of nuclear-powered aircraft carriers.

b. These numbers represent the Navy's estimate for new-ship construction, its estimates for cost-to-complete funding for ships purchased in prior years, and CBO's estimate for the refueling of nuclear-powered aircraft carriers and other items.

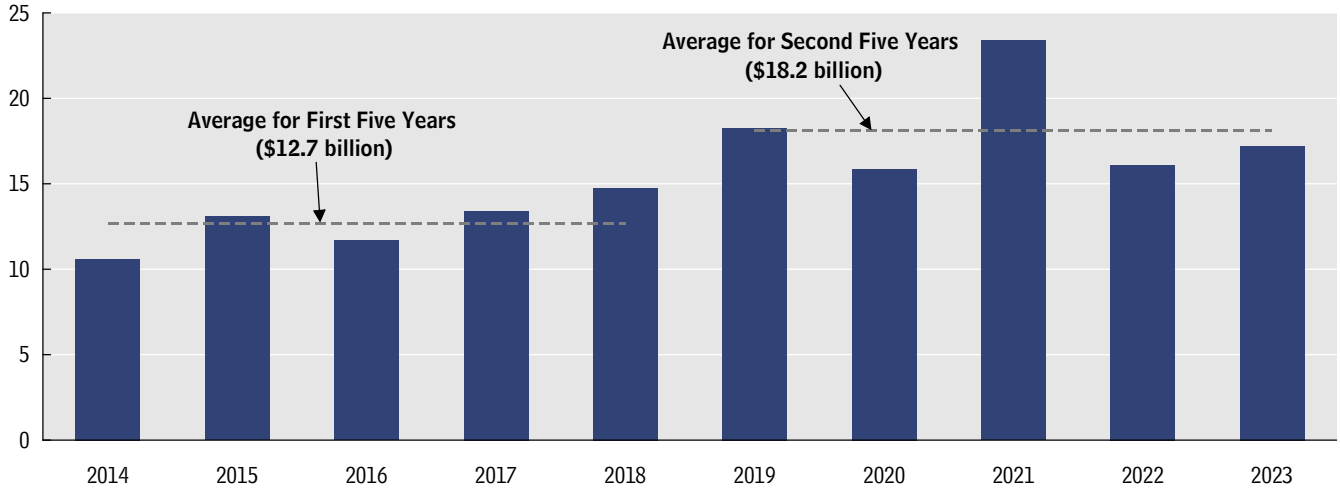
c. Includes new-ship construction only.

Adding the $1.4 billion in cost-to-complete funding that will be spent in 2014 and 2015 and the costs for other items listed above would boost the Navy's estimate for the full cost of the 2014 shipbuilding plan to $18.7 billion per year, or $1.9 billion more than the Navy's estimate for new ship construction alone. That figure is 18 percent higher than the average funding for total shipbuilding the Navy has received in the past three decades—$15.8 billion per year.

Figure 6.

The Navy's Estimates of New-Ship Construction, 2014 to 2023

(Billions of 2013 dollars)



Source: Congressional Budget Office based on data from the Department of the Navy.

Note: Costs of new-ship construction exclude funds for refueling nuclear-powered aircraft carriers. They also exclude funds for ship conversions, construction of ships that are not part of the Navy's battle force (such as oceanographic survey ships), training ships, outfitting and postdelivery costs (which include the purchase of many smaller tools and pieces of equipment that are needed to operate a ship but are not necessarily provided by the manufacturing shipyard as part of ship construction), and smaller items. Costs for the mission packages for littoral combat ships, which are not funded in the Navy's shipbuilding accounts, also are not included.

CBO's Estimates

In CBO's estimation, the full annual cost of the 2014 shipbuilding plan would average $21.2 billion over the 2014–2043 period—13 percent more than the Navy's estimate of $18.7 billion and 34 percent more than the average funding the Navy has received in the past three decades. CBO's estimates are only 5 percent higher than the Navy's for the first 10 years of the plan but are 23 percent higher for the last 10 years. The full costs have a fair amount of yearly variation but trend upward for the first two decades of the plan (see Figure 7). Looking at the 30-year period as a whole, CBO estimated that:

- Costs for new-ship construction alone would average $19.3 billion per year, 15 percent more than the Navy's figure of $16.8 billion (see Table 3 on page 13);
- New-ship construction plus refueling of nuclear-powered aircraft carriers would cost an average of $20.4 billion per year, 14 percent more than the Navy's figure of $17.8 billion; and
- All other items would add annual costs of about $900 million, raising CBO's estimate to an average of $21.2 billion per year through 2043, 13 percent more than the Navy's figure of $18.7 billion.

For the near term, CBO's and the Navy's cost estimates are similar because most of the ships that the Navy plans to buy are already under construction and their costs are reasonably well known. For the midterm and far terms however, CBO and the Navy made different assumptions about the size and capabilities of future ships that led to different cost estimates. In addition, CBO incorporated into its estimates (which are in constant 2013 dollars) the fact that costs for labor and materials would probably continue to grow faster in the shipbuilding industry than in the economy as a whole, as they have for the past several decades. The Navy does not allow for such faster growth in its estimates (see Box 2). That difference is much more pronounced in the last decade of the plan, after 20 or more years of compounded growth, than in the early years.

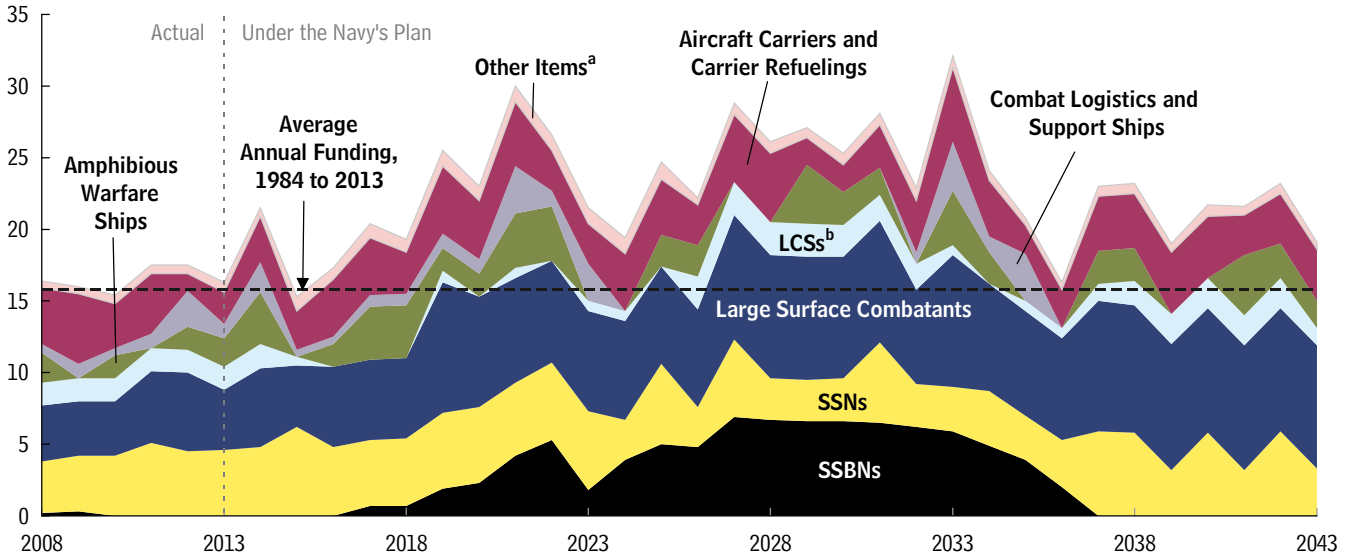
Costs of Reaching the Navy's Goal of a Fleet of 306 Ships

Under its 2014 shipbuilding plan, the Navy would not build enough ships at the right times to meet the service's inventory goal of 306 battle force ships until 2037. In particular, the plan would lead to temporary shortfalls relative to the Navy's goals for ballistic missile

Figure 7.

CBO's Estimates of Annual Shipbuilding Costs Under the Navy's 2014 Plan

(Billions of 2013 dollars)



Source: Congressional Budget Office based on data from the Department of the Navy.

Note: LCSs = littoral combat ships; SSNs = attack submarines; SSBNs = ballistic missile submarines.

a. Other items include funds for ship conversions, construction of ships that are not part of the Navy's battle force (such as oceanographic survey ships), training ships, outfitting and postdelivery costs (which include the purchase of many smaller tools and pieces of equipment needed to operate a ship but not necessarily provided by the manufacturing shipyard as part of ship construction), and smaller items.

b. Costs for the mission packages for littoral combat ships, which are not funded in the Navy's shipbuilding accounts, are not included.

submarines, attack submarines, large surface combatants, and amphibious warfare ships (see Figure 4 on page 10).

The shortfalls could be avoided or reduced by lowering the inventory goals for the various types of ships or, in many cases, by accelerating or increasing ship purchases beyond those specified in the 2014 shipbuilding plan. To meet the existing goals, the Navy could make several changes to the current shipbuilding plan:

- To prevent the ballistic missile submarine force from falling below the inventory goal of 12 submarines, the Navy could purchase the second new submarine in 2023 instead of 2024 and build 1 per year thereafter. All 12 boats would then be purchased by 2033, rather than 2035 as in the Navy's 2013 and 2014 plans. However, building a new class of large, technically complex submarines faster than the Navy plans would increase the technical risks.

- To prevent the attack submarine force from falling below the inventory goal of 48 submarines, the Navy could accelerate the purchase of 6 submarines. Specifically, it could purchase 6 additional submarines from 2019 through 2024, increasing the production rate to 3 submarines per year for most of those years. If that increase occurred, the Navy could buy 6 fewer attack submarines between 2025 and 2034 than are called for under the 2014 plan and still maintain the desired inventory level.

- To meet its goal of 88 large surface combatants, the Navy could purchase 8 additional destroyers between 2020 and 2029, increasing the production rate to 3 or 4 ships per year. If that increase occurred, the Navy could buy 7 fewer destroyers between 2030 and 2035 and still maintain the desired inventory level.

- The only way to prevent a shortfall in amphibious warfare ships relative to the Navy's goal in the first few years of the 2014 plan would be to not retire existing amphibious ships. Because ships of this sort take four to five years to build, construction of additional ships would not solve the shortfall over the next five years but would allow the Navy to meet its inventory goal of 33 ships after 2017.

Box 2.

Inflation in Shipbuilding

The costs of building future ships depends on the sizes and capabilities of those ships as well as on the evolution of the cost of building a ship of any given size and capability. The differences between the Navy's and the Congressional Budget Office's (CBO's) estimates of the cost of the Navy's shipbuilding plans arise in part because of differences in the projected future cost of building a ship of any given size and capability.

The Navy provided CBO with a historical index of shipbuilding costs between 1960 and 2012; that index measures the historical growth in the costs of labor and materials used in shipbuilding. To project the increase in those costs for 2013 through 2019, the service extrapolated from that historical experience and also incorporated information from advance pricing agreements, vendor surveys, and projections of the cost of materials from the Bureau of Labor Statistics. For those years, the Navy projects that the index of shipbuilding costs will increase at an average annual rate of 2.9 percent. By comparison, CBO projects that the gross domestic product (GDP) price index, which measures the prices of all final goods and services produced in the economy, will increase at an average annual rate of 2.0 percent during those years. Thus, CBO estimates that the cost of building a given ship will increase between 2013 and 2019 at a rate that is 0.9 percentage points faster per year, on average, than inflation for the economy as a whole.

That difference in projected inflation rates is smaller than the 1.3 percentage point difference when CBO published its analysis of the Navy's 2013 plan. Since 1983, the difference between the rate of increase in the Navy's shipbuilding cost index and the GDP price index has averaged about 1.3 percentage points per year (see the figure to the right).

The Navy incorporated that 2.9 percent per year projected increase in shipbuilding costs into its budget request for 2014 and into the associated Future Years Defense Program; both of those documents express costs in nominal dollars. However, in projecting the constant-dollar costs for its 2014 shipbuilding plan, the Navy did not allow for a difference between shipbuilding inflation and overall inflation. Instead, the 2014 shipbuilding plan incorporates the view that a ship that costs $2.5 billion to build in 2013 would cost the same (in 2013 dollars) to build in 2030 or 2040.

In contrast, CBO projects that inflation in shipbuilding will exceed overall inflation for the next 30 years—partly because cost growth in the shipbuilding industry has exceeded general inflation for most of the past three decades and partly because CBO lacks an analytic basis for determining when and to what extent the difference between the two growth rates might narrow. CBO projects that shipbuilding inflation will outpace inflation as measured

Continued

According to CBO's estimates, incorporating those changes into the Navy's 2014 plan would raise costs in the first decade of the plan and lower costs in the second and third decades. The cost of new-ship construction would average $18.5 billion between 2014 and 2023 (instead of $16.3 billion, as under CBO's estimate of the Navy's plan), $21.2 billion between 2024 and 2033 (instead of $22.6 billion), and $17.7 billion between 2034 and 2043 (instead of $19.1 billion). Over the entire 30-year period, new-ship construction would average $19.1 billion per year—virtually the same as CBO's estimate of the Navy's plan, although greater front-loading of those costs raises their present value.[12]

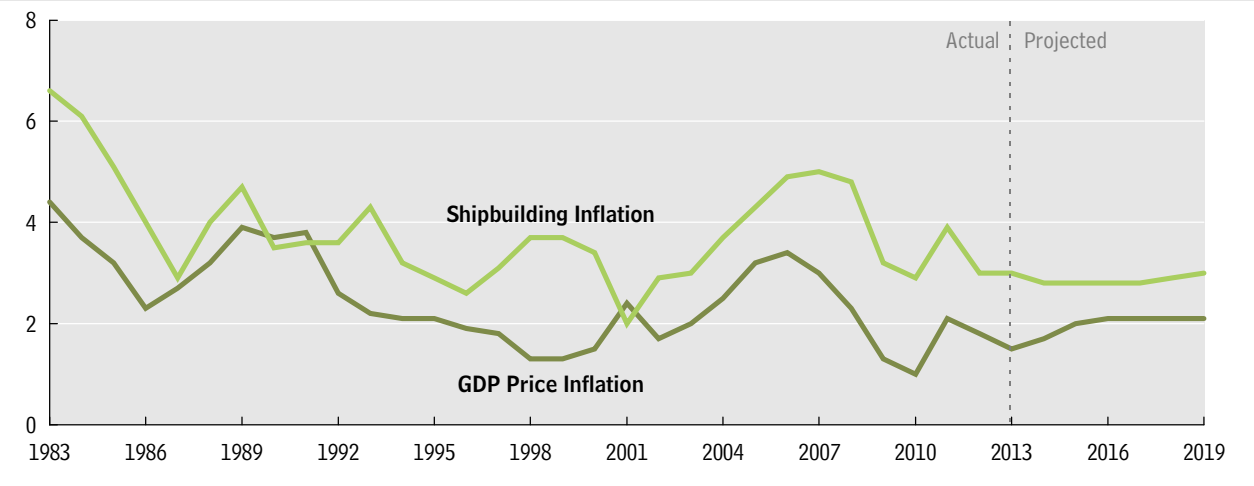
Other approaches to prevent falling short of the inventory goal of 306 ships could have different costs. For example, if the Navy was able to extend the service life of

12. Present value is a single number that expresses a flow of current and future income (or payments) in terms of an equivalent lump sum received (or paid) today. The present value depends on the rate of interest, known as the discount rate, that is used to translate future cash flows into current dollars.

Box 2. **Continued**

Inflation in Shipbuilding

Annual Rates of Shipbuilding Inflation and GDP Price Inflation



Source: Congressional Budget Office based on data from the Department of the Navy.

Note: GDP = gross domestic product.

by the GDP price index by 0.9 percentage points per year between 2013 and 2019 and by 1.3 percentage points per year—the 30-year historical average—thereafter. That difference represents projected growth in the cost of a future ship of any given size and capability relative to prices for the average good or service in the economy.[1] For example, CBO estimates that a ship costing $2.5 billion to build in 2013 would cost $3.1 billion (in 2013 dollars) to build in 2030. Nevertheless, shipbuilding costs cannot continue indefinitely to grow faster than the costs of goods and services in the economy as a whole. If that were to happen, the price of ships would eventually outstrip the Navy's ability to pay for them, even in very small numbers.

1. Including the historical difference between shipbuilding costs and overall inflation in the economy is necessary to ensure that the historical growth in shipbuilding costs is fully accounted for in CBO's estimates.

some existing ships, it would need fewer new ships, thus lowering procurement costs but possibly increasing operation and maintenance costs because older ships tend to be more expensive to operate than newer ships. However, the Navy's plan already assumes that most destroyers will be in service for 40 years, while historically very few have served longer than 30 years. Consequently, CBO does not expect that those ships could serve for an even longer period in order to prevent the shortfall in large surface combatants.

Shipbuilding Given Historical Average Funding Amounts

CBO's estimate of $21.2 billion per year for the full cost of the Navy's 2014 shipbuilding plan is 34 percent higher than the $15.8 billion the Navy has spent on average per year for all items in its shipbuilding accounts over the past 30 years. If the Navy's future funding for shipbuilding is in line with its past funding, the Navy would need to reduce substantially the number of ships it purchased compared with its 2014 plan. To illustrate how much smaller the fleet of battle force ships would be under that scenario, CBO constructed an alternative shipbuilding

plan to meet two criteria. First, the purchase of specific types of ships would be reduced relative to the 2014 plan in rough proportion, so the distribution of the fleet in 2043 among types of ships would be about the same as it would be in the 2014 plan, although the number of ships of each type would be smaller. Second, spending would be fairly similar during the near term, midterm, and far term planning periods. That alternative plan is not a recommendation by CBO but simply an illustration of the possible consequences of continuing funding for shipbuilding at its historical average amount rather than increasing it, as would be required under the Navy's 2014 plan.

Purchases under that alternative plan would number 193 ships (versus 266 in the Navy's plan), including 157 combat ships and 36 support ships. The purchases of combat ships would include:

- 5 aircraft carriers (compared with 6 in the Navy's plan),
- 9 ballistic missile submarines (compared with 12 in the Navy's plan),
- 35 attack submarines (compared with 47 in the Navy's plan),
- 51 destroyers (compared with 70 in the Navy's plan),
- 46 littoral combat ships (compared with 66 in the Navy's plan), and
- 11 amphibious ships (compared with 19 in the Navy's plan).

Under that alternative plan, the battle force fleet in 2023 would be about the same size as in the Navy's plan but by 2043 would number 243 ships, as opposed to the 306 ships in the Navy's plan. The inventory in 2043 would include:

- 8 aircraft carriers (compared with 10 in the Navy's plan),[13]
- 9 ballistic missile submarines (compared with 12 in the Navy's plan),
- 41 attack submarines (compared with 51 in the Navy's plan),
- 73 destroyers (compared with 88 in the Navy's plan),
- 33 littoral combat ships (compared with 52 in the Navy's plan),
- 27 amphibious ships (compared with 29 in the Navy's plan), and
- 52 support ships (compared with 62 in the Navy's plan).

Other approaches to staying within historical funding amounts could have very different results. If the Navy reduced the number of larger and more expensive ships more sharply than in the alternative plan described above, then the overall fleet would be larger. Conversely, if the Navy preserved the programs of more expensive ships, then the overall fleet would be smaller. Ultimately, decisions about which ships to build would depend on the priorities that policymakers established for certain naval missions relative to others. For example, stressing strategic deterrence as the Navy's top priority, as the Chief of Naval Operations did in recent testimony before the Congress, could lead to the Navy's buying the entire force of 12 new ballistic missile submarines envisioned in the 2014 plan, even if shortfalls in funding required substantial cuts in other shipbuilding relative to that plan.

Shipbuilding Under the Budget Control Act of 2011

The BCA imposed caps on annual appropriations for defense from 2013 through 2021; it also established procedures that led to automatic spending reductions, including a lowering of the caps on defense funding for 2014 through 2021. Under those lower caps, the Department of Defense will receive funding for its base budget—which excludes the cost of overseas contingency operations, such as the war in Afghanistan—that is substantially lower in real terms than the funding it received in 2010, when such funding reached its peak. Specifically, DoD's base budget (after adjusting for inflation) will fall

13. The alternative plan would also fund one fewer carrier refueling.

in 2014 to about the amount that the department received in 2007 and will then remain essentially flat through 2021.[14]

During the past 15 years, the Department of the Navy has received about 30 percent of DoD's base budget, and it has devoted about 10 percent of its funding to shipbuilding. If the Navy receives the same percentage of DoD's budget during the coming decade and devotes the same percentage of its budget to ship construction that it has historically, the shipbuilding budget would be a little less than $13 billion per year from 2014 through 2021. That amount would be $5.5 billion per year—or 30 percent—below CBO's estimate of the amount required by the Navy's 2014 shipbuilding plan. Whether DoD funding would be allocated in that proportional manner is unclear, although the department's recently completed Strategic Choices Management Review (SCMR) indicated that substantial cuts to military forces, including battle force ships, would be likely if DoD received the amounts specified in the BCA.[15]

Outlook for Specific Ship Programs

To estimate the costs of implementing the Navy's 2014 shipbuilding plan, CBO calculated the cost of each of the 266 ships that the Navy intends to purchase from 2014 through 2043. For ships under construction, the estimates were based in part on data for actual costs from the Navy; for ships yet to be built, the estimates were based on relationships between the cost and weight of similar ships in the past. Specifically, CBO used the cost per thousand tons of lightship displacement—the weight of the ship itself without its crew, materiel, weapons, or fuel. CBO then adjusted its estimates to incorporate the effects of "rate" (the reduction in average overhead costs that occurs when a shipyard builds more than one of the same type of ship at a time) and "learning" (the efficiencies that shipyards gain as they produce additional units of a given type of ship). The effects of rate and learning were applied to the estimated cost of the first ship of a class (the lead ship) to determine the estimated costs for all subsequent ships of that class. Thus, CBO's estimate of the cost of the lead ship in a class drove its estimate of the costs of subsequent ships of that class. To estimate the costs of ships for which the Navy has yet to develop even notional designs, CBO had to make assumptions about the size and capabilities of those ships. All costs of individual ships described in this section exclude outfitting and postdelivery costs, which typically add about 3 percent to the cost of a ship.

A source of uncertainty in estimating the cost of major ship programs is how competition among shipbuilders will affect costs. The effects of past competition on ship costs—for example, in the littoral combat ship program—are reflected in the historical cost information that are the basis of the Navy's and CBO's estimates of the cost of future ships. However, competition among shipbuilders may have a larger effect on ship costs in the future because the Navy plans to open up more shipbuilding programs to head-to-head competition. According to the Navy, recent competitions for the two blocks of 10 littoral combat ships purchased in 2010 and for multiyear procurement contracts for destroyers resulted in savings of 15 to 30 percent compared with prices that might have been offered in an uncompetitive, sole-source procurement. If future competitions generate similar savings, the costs of some of the ships discussed in this section would be lower than what the Navy and CBO estimate.

Aircraft Carriers

The 2014 shipbuilding plan states that the Navy's goal is to have 11 aircraft carriers. The Navy intends to buy 6 CVN-78 Gerald R. Ford class aircraft carriers over the 2014–2043 period. Building 1 carrier every five years (referred to as five-year centers) will enable the Navy to have a force of at least 11 carriers almost continuously through 2043, with two exceptions. One exception will be from 2013 to 2016, when the number of carriers drops to 10. That temporary decline would occur because the *Enterprise* (CVN-65) retired in early 2013 after 52 years of service, and the next new carrier, the *Gerald R. Ford* (CVN-78), will not be commissioned until 2016. Any delays in completing that new carrier would extend the period during which the Navy had only 10 carriers. The other exception would be from 2040 to 2043 and beyond; because carriers would be built every five years

14. For a more thorough discussion of the Budget Control Act and its effect on the Department of Defense, see Congressional Budget Office, *Approaches for Scaling Back the Defense Department's Budget Plans* (March 2013), www.cbo.gov/publication/43997.

15. Deputy Secretary of Defense Ashton B. Carter and Vice Chairman of the Joint Chiefs of Staff James A. Winnefeld, Jr., Prepared Testimony, House Armed Services Committee, August 1, 2013, http://go.usa.gov/DMaH (PDF, 2 MB).

and serve for 50 years, the Navy's carrier force would fall to 10 in 2040.

The Navy currently projects that the cost of the lead ship of the CVN-78 class will be $12.8 billion in nominal dollars (which is just below the new Congressional cost cap of $12.9 billion.) Using the Navy's inflation index for naval shipbuilding, CBO converted that figure to $13.9 billion in 2013 dollars.[16] That amount is 22 percent more than the President's budget requested in 2008 when the ship was authorized. The Navy's estimate does not include $4.7 billion in research and development costs that apply to the entire class. In its 2014 budget request, the Navy requested an extra $506 million in nominal dollars in 2014 and 2015 ($483 million in 2013 dollars) to cover additional cost growth and additional tooling and vendor services; that amount is included in the Navy's estimate.

CBO estimates that the cost of the lead ship of the CVN-78 class will be $13.5 billion in nominal dollars and $14.5 billion in 2013 dollars. To generate that estimate, CBO used the actual costs of the previous carrier—the CVN-77—and adjusted them for the higher costs of government-furnished equipment and for more than $3 billion in costs for nonrecurring engineering and detail design (the plans, drawings, and other one-time items associated with the first ship of a new class). Subsequent ships of the CVN-78 class will not require as much funding for one-time items, although they will incur the same costs for government-furnished equipment. Altogether, CBO estimates the average cost of the 6 carriers in the 2014 plan at $12.7 billion, compared with the Navy's estimate of $12.5 billion (see Table 4).

The final cost of the CVN-78 could be higher or lower than CBO's estimate. Possible reasons for a higher cost include the following:

- The costs of many lead ships built in the past 20 years have increased more than 30 percent from the original budgeted estimate. CBO's estimate of the cost of the CVN-78 incorporates an amount of growth that falls within the range of historical cost growth for lead ships. However, construction of the ship is only about 60 percent complete, and costs have tended to rise more in the latter stages of ship construction, when systems are being installed and integrated.

- The Navy has stated that there is a 50 percent probability that the cost of the CVN-78 will exceed its estimate. Specifically, in its most recent Selected Acquisition Report, the Navy stated that it has budgeted an amount for the CVN-78 that covers up to the 50th percentile of possible cost outcomes. By comparison, in a written response to CBO and the Congressional Research Service last year, the Navy stated that it had budgeted an amount "greater than [the] 50th percentile" (though without specifying how much greater).

- The Navy has stated that the test program for the carrier could reveal one or more major, possibly expensive, problems.

Possible reasons for a lower cost than CBO's estimate include the following:

- The Navy and the builder of the CVN-78 recognize that cost growth for lead ships is a significant concern, and they are actively managing the CVN-78 program to restrain costs.

- All of the materials for the CVN-78 have been purchased, and much of the equipment for the vessel is being purchased under fixed-price contracts—which essentially eliminates the risk of further cost growth for about half of the projected cost of the carrier.

- A successful test program that revealed only minor problems would likely limit additional costs to less than $100 million.[17]

The next carrier following the CVN-78 will be the CVN-79, the *John F. Kennedy.* Funding for that ship

16. Using a different method, the Navy estimated that the $12.8 billion cost in nominal dollars for the lead ship would be a little over $15 billion in constant 2013 dollars. The Navy's calculation is based on a unique method that is not comparable to CBO's method for estimating costs in constant dollars and is not used by the Navy to estimate costs in constant dollars for any other shipbuilding program. If CBO used the Navy's unique method to convert its own estimate for the carrier program (which involves using different carrier-specific inflation indexes for different cost components of the ship) from nominal dollars to constant dollars, CBO's estimate for the CVN-78 would still be about $600 million more than the Navy's.

17. A successful test program that revealed only minor problems could still cost more than the Navy estimates but would likely be lower CBO's estimate.

Table 4.

Comparison of the Navy's and CBO's Estimates of the Cost of Construction of Major New Ships Under the Navy's 2014 Plan

(Billions of 2013 dollars)

	Number of Ships Purchased Under the 2014 Plan	Total Costs per Class Over the 2014–2043 Period		Average Costs per Ship Over the 2014–2043 Period		Memorandum: Average Costs per Ship Under the 2013 Plan	
		Navy's Estimates	CBO's Estimates	Navy's Estimates	CBO's Estimates	Navy's Estimates	CBO's Estimates
CVN-78 Gerald R. Ford Class Aircraft Carriers	6	73 [a]	75 [a]	12.5 [a]	12.7 [a]	11.2	13.4
SSBN(X) Ballistic Missile Submarines (Replacements for Ohio class)	12	77	87	6.4	7.2	6.7	7.7
Virginia Class Attack Submarines	33	90	89	2.7	2.7	2.8	2.8
Improved Virginia Class Attack Submarines (Replacements for Virginia class)	14	45	43	3.2	3.1	3.0	3.3
DDG-51 Arleigh Burke Class Destroyers							
Flight IIA	4	6	6	1.5	1.6	1.6	1.8
Flight III	33	58	63	1.8	1.9	2.2	2.5
DDG(X) Destroyers (Replacements for Arleigh Burke class)	33	64	108	2.0	3.3	2.3	3.4
Littoral Combat Ships	36	16	19	0.4 [b]	0.5	0.5	0.5
LCS(X)s (Replacements for littoral combat ships)	30	13	18	0.4 [b]	0.6	0.4	0.6
LX(R)s (Replacements for amphibious dock landing ships)	11	15	18	1.4	1.6	1.4 [c]	1.8 [c]
LHA-6 Amphibious Assault Ships	6	22	26	3.6	4.3	3.7	4.4
T-AO(X) Oilers	17	8	9	0.5	0.5	0.5	0.5

Source: Congressional Budget Office based on data from the Department of the Navy.

Notes: The costs in this table exclude funding for research and development for these ships.

Relative to Table 1, this table excludes 2 LPD-17 replacement amphibious warfare ships and 29 support ships of various types.

a. Funding for aircraft carriers is spread out over a six-year period. Thus, in CBO's and the Navy's estimates for aircraft carriers, total costs per class include funds for the CVN-78 and CVN-79 that would be appropriated in 2014 or later, even though those ships were authorized in 2008 and 2013, respectively. Total costs per class also include funds that would be appropriated in 2043 and prior years for the aircraft carrier the Navy plans to buy in 2043, but does not include funds that would be appropriated for that ship after 2043. CBO's and the Navy's estimates of the average cost per ship include all funds for the construction of the 6 ships the Navy plans to purchase over the 2014–2043 period, regardless of the years in which the funds are appropriated.

b. The Navy's estimate for the littoral combat ships (LCSs) is $446 million per ship, and its estimate for the LCS(X)—the replacement ship—is $433 million. Those costs exclude the cost of LCS mission packages, which CBO also excluded from its estimates.

c. Under the 2013 plan, this ship was designated as the LSD(X) amphibious dock landing ship.

began in 2007, the Congress officially authorized its construction in 2013, and appropriations for it are expected to be complete by 2018. The Navy estimates that the ship will cost $10.2 billion in 2013 dollars, or $11.3 billion in nominal dollars. In its new Selected Acquisition Report on the CVN-79, the Navy describes its cost estimate as an "aggressive but achievable target." In contrast, CBO estimates that the cost of the ship will be $11.3 billion in 2013 dollars, or about 10 percent more than the Navy's estimate, and $12.0 billion in nominal dollars.

Submarines

Under the 2014 shipbuilding plan, submarines would overtake surface combatants as the largest source of demand for shipbuilding funds over the next 20 years (see Table 5). The Navy currently operates 14 Ohio class

Table 5.

Total Shipbuilding Costs, by Major Category, 1984 to 2043

	Historical				CBO's Estimates Under the Navy's 2014 Plan			
	1984-1993	1994-2003	2004-2013	1984-2013	2014-2023	2024-2033	2034-2043	2014-2043
	Average Annual Costs (Billions of 2013 dollars)							
New-Ship Construction								
Aircraft carriers	1.5	1.6	1.8	1.6	2.4	2.4	2.7	2.5
Submarines	6.9	2.2	3.8	4.3	6.8	9.6	5.4	7.3
Surface combatants	7.6	4.6	4.1	5.4	5.4	6.7	9.3	7.1
Amphibious ships	1.6	1.4	1.9	1.6	1.0	2.5	1.3	1.6
Logistics and support ships	1.9	0.3	0.8	1.0	0.8	1.2	0.3	0.8
Subtotal	19.5	10.1	12.4	14.0	16.3	22.6	19.1	19.3
Carrier and Submarine Refuelings[a]	0.4	0.8	1.2	0.8	1.2	1.1	0.8	1.0
Other Items	1.1	1.2	0.6	1.0	1.0	0.8	0.6	0.8
Total	**21.0**	**12.1**	**14.2**	**15.8**	**18.5**	**24.5**	**20.5**	**21.2**
	Percentage of Average Annual Costs							
New-Ship Construction								
Aircraft carriers	8	16	14	12	13	10	13	12
Submarines	36	22	30	31	37	39	26	34
Surface combatants	39	46	33	39	29	27	46	34
Amphibious ships	8	14	15	12	5	10	6	8
Logistics and support ships	10	3	6	7	4	5	2	4
Subtotal	93	84	87	89	88	92	93	91
Carrier and Submarine Refuelings[a]	2	6	9	5	6	5	4	5
Other Items	5	10	4	6	5	3	3	4
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Congressional Budget Office.

Note: Costs of new-ship construction exclude funds for refueling nuclear-powered aircraft carriers. They also exclude funds for ship conversions, construction of ships that are not part of the Navy's battle force (such as oceanographic survey ships), training ships, outfitting and postdelivery costs (which include the purchase of many smaller tools and pieces of equipment that are needed to operate a ship but are not necessarily provided by the manufacturing shipyard as part of ship construction), and smaller items. Costs for the mission packages for littoral combat ships, which are not funded in the Navy's shipbuilding accounts, also are not included.

a. CBO's estimates under the Navy's 2014 plan reflect only the costs of refueling aircraft carriers. Historically, the refueling of nuclear-powered submarines was also included in the Navy's shipbuilding accounts. In 2010, however, the Navy transferred the funding for those refuelings to other accounts.

ballistic missile submarines (SSBNs), 4 Ohio class guided missile submarines (SSGNs) modified from the SSBN version, and 55 attack submarines (SSNs) of several classes. Over the next three decades, the Navy plans to buy 12 new SSBNs starting in 2021; 33 Virginia class attack submarines at a rate of mostly 2 per year through 2033; and 14 submarines based on a redesign and improvement of the Virginia class, with production of the new version to start in 2034. The Navy does not plan to replace its 4 SSGNs when they are retired in the mid- to late 2020s.

SSBN(X) Ohio Replacement Ballistic Missile Submarines. SSBNs carry Trident ballistic missiles and are the sea-based leg of the United States' strategic triad for delivering nuclear weapons. (The other two legs are

land-based intercontinental ballistic missiles and manned strategic bombers.) The design, cost, and capabilities of the SSBN(X)—the submarine class slated to replace the Ohio class—are among the most significant uncertainties in the Navy's and CBO's analyses of the cost of future shipbuilding. Under the 2014 plan, the first SSBN(X) would be purchased in 2021, although advance procurement funds would be needed starting in 2017 for items with long lead times. The second submarine would be purchased in 2024, followed by 1 per year from 2026 to 2035 (see Figure 3 on page 8).

The recent history of cost estimates for the SSBN(X) illustrates both the high expected costs of the program and the uncertainty regarding those costs. The Navy's 2007 and 2008 shipbuilding plans included a projection that the SSBN(X) would cost an average of $3.8 billion (in 2013 dollars) per ship. The 2011 plan estimated the costs of the SSBN(X) class at an average of $7.9 billion apiece, while under the 2012 plan, the cost was lowered to $6.7 billion.[18] The Navy currently estimates the cost of the lead SSBN(X) at $12.0 billion. The estimated average cost of follow-on ships is now $5.9 billion, and the Navy has stated an objective of reducing that cost to $5.4 billion in 2013 dollars.[19] All told, the Navy estimates that building 12 submarines will cost $77 billion, an average of $6.4 billion each.

Between the 2011 and 2012 plans, the Navy redefined its SSBN(X) design with the primary goal of reducing the cost. The Navy's cost estimate in the 2011 plan was based on a design similar in size to the Ohio class and on the cost of building Ohio class submarines using contemporary technology and under current conditions of the shipbuilding industry (such as the number of shipbuilders and vendors and the amount of other business in the shipyards). The Navy states that it was able to reduce the estimated cost of the SSBN(X) to the current projection by making the following changes:

- Using a less expensive and more specific basic design (eliminating some costs in the estimate for the 2011 plan that were associated with uncertainty);
- Reducing the number of missile tubes from 20 to 16;
- Reducing the diameter of the missile tubes from 97 inches to 87 inches, which is the minimum needed to launch the Trident D-5 submarine-launched ballistic missile;
- Reducing the capability of the torpedo room and various sensor arrays and reducing the size of the sail mast;
- Increasing the use of components from the Virginia class attack submarines; and
- Simplifying many small elements in the design of the new submarine.[20]

While the Navy estimates that the lead SSBN(X) will cost $12.0 billion, CBO estimates that it will cost $13.0 billion. Estimating the cost of the first submarine of a class is particularly difficult because it is not clear how much the Navy will spend on nonrecurring engineering and detailed design. The Navy spent about $2 billion on those items for the lead Virginia class attack submarine. The historical record for the lead ship of new classes of submarines in the 1970s and 1980s indicates that there is little difference in those items on a per-ton basis between a lead attack submarine and a lead SSBN. Therefore, CBO projects that the cost of nonrecurring engineering and detailed design is proportional to the weight of submarines, which implies that nonrecurring items would cost about $5 billion for the lead SSBN(X)—a submarine that will be somewhat larger than an Ohio class submarine and about 2½ times the size of a Virginia class submarine. The Navy's estimate for the lead SSBN(X) takes into account nonrecurring costs of an estimated $4.5 billion.

18. The Navy's 2009 plan did not include a cost estimate for the SSBN(X), and the Navy did not submit a plan for fiscal year 2010.

19. Briefing by the Navy to the staff of the House Committee on Armed Services, CBO, and the Congressional Research Service, February 28, 2011. The Navy's numbers in that briefing, expressed in 2010 dollars, were $5.6 billion for the average follow-on submarine with an objective of reducing it to $4.9 billion. Although the Navy's 2014 plan does not yet reflect it, the Navy's Ohio Replacement program office currently estimates that it has reduced the cost to $5.4 billion in 2010 dollars.

20. For more information, see Ronald O'Rourke, *Navy SSBN(X) Ballistic Missile Submarine Program: Background and Issues for Congress,* CRS Report for Congress R41129 (Congressional Research Service, September 25, 2013); and the statement of Eric J. Labs, Senior Analyst for Naval Forces and Weapons, Congressional Budget Office, before the Subcommittee on Seapower and Expeditionary Forces of the House Committee on Armed Services, *The Long-Term Outlook for the U.S. Navy's Fleet* (January 20, 2010), www.cbo.gov/publication/41886.

All told, 12 SSBN(X)s would cost about $87 billion in CBO's estimation, or an average of $7.2 billion each—$0.8 billion higher per boat than the Navy's estimate. That average includes the $13.0 billion estimated cost of the lead submarine and a $6.7 billion average estimated cost for the 2nd through 12th submarines. Research and development would cost an additional $10 billion to $15 billion, for a total program cost of $97 billion to $102 billion, CBO estimates.

Attack Submarines. Under the 2014 plan, the Navy would buy 33 Virginia class attack submarines. Between 2014 and 2027, those purchases would occur mostly at a rate of 2 per year, with the exceptions of 2024 and 2026, when the Navy would buy 1 per year. Between 2028 and 2036, those purchases would occur mostly at a rate of 1 per year, with a switch to an improved Virginia class beginning in 2034. Beginning in 2037, the service would buy those submarines at a rate of 1 or 2 per year through 2043. With such a procurement schedule, the attack submarine force would remain at or above the Navy's goal of 48 submarines through 2024 but would then fall to between 42 and 47 submarines between 2025 and 2034 before reaching or exceeding 48 submarines again between 2035 and 2043 (see Figure 4 on page 10).

Senior Navy leaders have stated that Virginia class SSNs would have to cost $2.7 billion or less for the Navy to be able to afford 2 per year, and the 2014 shipbuilding plan assumes that they would.[21] The President's 2014 budget indicates a cost of $2.5 billion. According to the Navy's estimates, the total cost for all of the Virginia class submarines purchased between 2014 and 2033 would be about $90 billion—very close to CBO's estimate of $89 billion.

The Navy has assumed in recent plans that the improved Virginia class would be a further evolution of the current Virginia class, which itself incorporates regular technological upgrades to its systems and capabilities. Similarly, CBO assumed that the replacement for the Virginia class would incorporate technological improvements that would be sufficiently important to make the improved submarines a new class but would not constitute an entirely new design. On the basis of that assumption, CBO estimated that the average cost of the improved Virginia class would be $3.1 billion, compared with the Navy's estimate of $3.2 billion.

Although the Navy's plan does not include submarines to replace the existing SSGNs when they retire in the 2020s, the service is considering an option to physically lengthen the Virginia class design and insert four large-diameter payload tubes, each of which could carry seven Tomahawk missiles. That change would increase the submerged displacement of the submarine by nearly 30 percent and would raise the number of the Virginia class's vertical-launch weapons from 12 to 40 (in addition to the 27 weapons in the torpedo room). The Navy estimates that 20 Virginia class submarines that had those additional payload modules would provide a "near equivalent" to the strike capability of the existing force of 4 SSGNs. The President's 2014 budget proposed spending $600 million between 2014 and 2018 for research and development of the payload module and for modifying the design of the Virginia class. If the payload module was included in submarine purchases after 2017, the modified boats would require greater funding than what the Navy or CBO estimates for the 2014 plan.

Large Surface Combatants

The Navy's 2014 plan incorporates the purchase of the same types of destroyers as the 2013 plan. The service restarted the production of DDG-51 Flight IIA destroyers in 2010 and purchased 6 ships through 2013 (in addition to the 62 ships that had been purchased when production was initially stopped in 2005.) An additional ship was authorized by the Congress in the 2013 appropriations for DoD, but it is not clear at this point whether the Navy has sufficient funds to complete the purchase of that ship given the reduction in funding under the Budget Control Act.[22] The Navy plans to purchase 4 more DDG-51 Flight IIAs through 2016.

21. Specifically, the Navy has said that to purchase 2 Virginia class submarines a year, the cost would have to decline to $2.0 billion each in 2005 dollars, which is equivalent to $2.7 billion in 2013 dollars.

22. The fate of that destroyer apparently will be determined by the funding provided for fiscal year 2014. The Navy hopes to include the ship as part of a multiyear procurement contract for the ships purchased from 2013 through 2017. However, the reductions that were taken from the 2013 appropriation as a result of the automatic enforcement mechanism of the Budget Control Act left the Navy short of the funds it needed to include the additional ship in the multiyear contract. If the Navy receives the necessary appropriations in 2014, the ship would be purchased. If the Navy does not receive in 2014 the remaining funds it needs to include the ship in the procurement contract, then the ship apparently would not be purchased.

Beginning with 1 of 2 ships ordered in 2016 and then continuing through 2029, new DDG-51s would have an upgraded design, a configuration known as Flight III. In 2030, the Navy would start buying 33 DDG(X)s, an as-yet-undesigned destroyer intended to replace the DDG-51 class. Those programs, if implemented as planned, would allow the Navy to meet its goal of 88 large surface combatants in 2021, in 2024 through 2029, and again after 2037 (see Figure 4 on page 10).

In addition to the ship purchases, a critical element of the Navy's plan to achieve its projected inventory levels is to keep all DDG-51 Flight IIAs and subsequent destroyers serving in the fleet for 40 years. The class was originally designed to serve for 30 years, but the Navy has gradually increased the planned service life—first to 35 years and then, in the 2009 shipbuilding plan, to 40 years for Flight IIA and Flight III ships. Of the last 13 classes of destroyers and cruisers, 12 have been retired after having served 30 years or less, and many ships, including in recent years, Spruance class destroyers and some Ticonderoga class cruisers, have been retired after having served 25 years or less; the only exception was the CGN-9 *Long Beach*, a class of 1 ship. The Navy retired those ships for different reasons: because they reached the end of their service life, because they became too expensive to maintain in the waning years of their service life, or because improving their combat capabilities to meet existing threats was judged not cost-effective.[23] If the DDG-51 class met the same fate, the shortfall in achieving the Navy's inventory goal for destroyers and cruisers would grow substantially. (For an illustration of the effect on the force level of large surface combatants if the service life of those ships is only 35 or 30 years and if the Navy does not increase the number of ships it purchases, see Figure 8.)

DDG-51 Flight IIAs. The Navy's existing force of 62 DDG-51 destroyers was built in three primary configurations. The first 28 ships, designated Flight I or II, did not include a hangar for embarking helicopters, which play important roles in countering enemy submarines, attacks by small boats, and, to a lesser degree, mines. The next 34 ships, designated Flight IIA, included a hangar and were thus able to carry two helicopters or several ship-launched unmanned aerial vehicles.[24] In the Navy's 2014 plan, 4 new DDG-51s purchased through 2016 (in addition to 6 or 7 purchased between 2010 and 2013 but not yet in the fleet) would use the Flight IIA configuration but would also incorporate the latest ballistic missile defense capabilities.[25] Those ships would have an average cost of $1.6 billion, in CBO's estimation—about $100 million more than the Navy's per-ship estimate.

DDG-51 Flight IIIs. The Navy's strategy to meet combatant commanders' demand for greater ballistic missile defense capabilities than existing DDG-51s provide—and to replace Ticonderoga class cruisers when they are retired in the 2020s—is to modify the design of the DDG-51 Flight IIA destroyer substantially, creating a Flight III configuration.[26] That configuration would incorporate the new Air and Missile Defense Radar (AMDR), now under development, which is larger and more powerful than the radars on earlier DDG-51s. Adding the AMDR so that it could operate effectively would require increasing the amount of electrical power and cooling available on a Flight III.[27] With those changes and associated increases in the ship's displacement, a DDG-51 Flight III destroyer would cost about $300 million, or about 20 percent, more than a new

23. See the statement of Eric J. Labs, Senior Analyst for Naval Forces and Weapons, Congressional Budget Office, before the Subcommittee on Seapower and Expeditionary Forces of the House Committee on Armed Services, *The Navy's Surface Combatant Programs* (July 31, 2008), www.cbo.gov/publication/20065.

24. For a detailed discussion of the differences between the DDG-51 flights, see Norman Polmar, *The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet,* 19th ed. (Naval Institute Press, 2013), pp. 140–145.

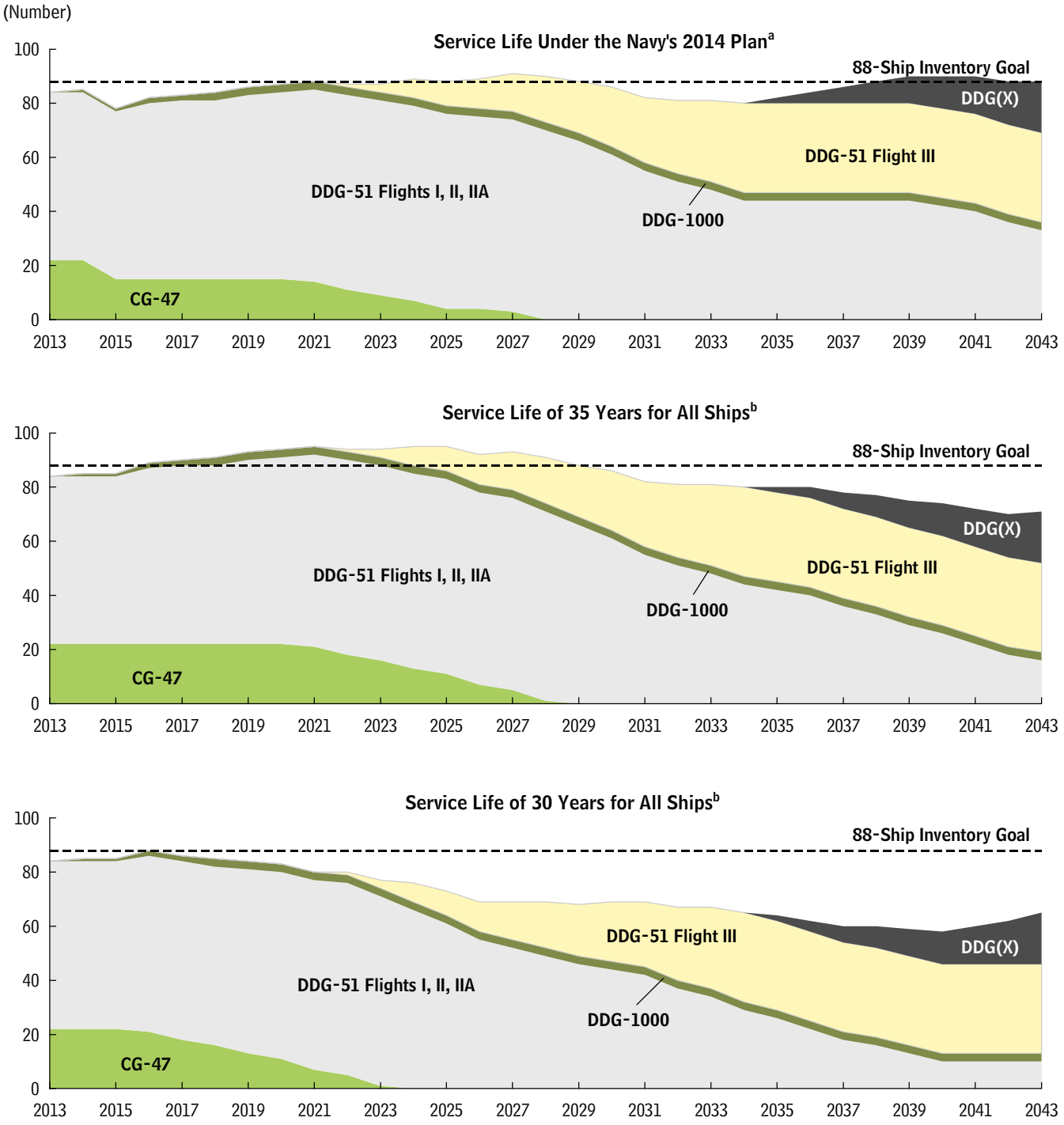
25. The Navy has announced that all existing DDG-51s will eventually be equipped with improved ballistic missile defenses; up to 32 of those upgrades will have been funded by the end of 2013. For more about the Navy's plans for the DDG-51 program, see Ronald O'Rourke, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress,* CRS Report for Congress RL32109 (Congressional Research Service, September 27, 2013).

26. Combatant commanders are the four-star generals or admirals who head the regional commands responsible for all U.S. military operations within their geographic areas.

27. See Ronald O'Rourke, *Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress,* CRS Report for Congress RL33745 (Congressional Research Service, September 20, 2013), and *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress,* CRS Report for Congress RL32109 (Congressional Research Service, September 27, 2013).

Figure 8.

Inventory of Large Surface Combatants Under Various Scenarios for Service Life



Source: Congressional Budget Office.

Notes: This figure does not include the additional destroyer authorized by Congress in 2013.

DDG = guided missile destroyer; CG = guided missile cruiser.

a. The Navy's 2014 plan assumes that DDG-51 Flights I and II and CG-47s would serve for 35 years and that all other ships would serve for 40 years.

b. These figures assume that the Navy retains the 7 CG-47s slated for retirement in 2015.

Flight IIA destroyer, CBO estimates.[28] Thus, the average cost per ship would be $1.9 billion. Overall, the Navy plans to buy 33 DDG-51 Flight III ships between 2016 and 2029.[29]

CBO's estimate of the costs of the DDG Flight IIA and Flight III ships to be purchased in the future is less than it was last year. Most of the decrease for the Flight III can be attributed to updated information on the cost of incorporating the AMDR into the Flight III configuration. The cost of the AMDR itself, according to the Navy, has declined steadily through the development program, and the Department of Defense's Cost Analysis and Program Evaluation (CAPE) office concurs in the reduced estimate. The Navy decreased its estimate for the average price of a DDG-51 Flight III ship from $2.2 billion in the 2013 plan to $1.8 billion in the 2014 plan, primarily as a result of the reduced cost of the AMDR. CBO reduced its estimate by a similar amount. Considerable uncertainty remains in the DDG-51 Flight III program, however. Costs could be higher or lower than CBO's estimate, depending on how well the restart of the DDG-51 program goes, on the eventual cost and complexity of the AMDR, and on associated changes in the ship's design to integrate the new radar.

DDG(X) Future Guided Missile Destroyers. Like the Navy's 2013 shipbuilding plan, the current plan includes a future class of destroyers intended to replace the DDG-51 Flight I and II ships when they retire in the late 2020s and 2030s.[30] The 2014 plan designates those ships as the DDG-51 Flight IV, consistent with the 2012 and 2013 plans, whereas the 2011 plan used a more generic DDG(X) designation. CBO uses the DDG(X) designation because the agency considers it unlikely that the Navy would or could use the DDG-51 design for the next-generation destroyer.

Under the 2014 plan, production of the DDG(X) would start in 2030, which would make it a successor to the DDG-51 Flight III program. Some Navy officials have suggested that the DDG(X) could be based on the hull and configuration of the DDG-51 class but incorporate technological improvements appropriate for the late 2020s and early 2030s. According to the Navy, it would buy 33 DDG(X)s at an average cost of $2.0 billion, or about $200 million more than the cost of DDG-51 Flight III ships. Those cost estimates imply that the DDG(X)'s capabilities would be a relatively modest improvement over those of the DDG-51 Flight III, and the Navy's use of the Flight IV designation suggests that it would retain the DDG-51 hull and simply improve the systems on it. However, the DDG-51 Flight III design consumes almost all available space on the ship and leaves only a small margin for further growth over the life of the ship. Unless the Flight IV systems require less power, weight, and space than the Flight III systems—which would be contrary to the historical trend of improvements to surface combatants requiring more power, weight, and space—then it is not clear that major upgrades to the DDG-51 Flight III constituting a new flight would be possible.

CBO, in contrast, expects that the DDG(X) would have a largely new design and would be about 10 percent heavier than the DDG-51 Flight III. By 2030, when the first DDG(X) would be authorized under the current plan, the initial DDG-51 design would be about 50 years old. The Navy has made and will continue to make improvements to the DDG-51 class, as the plans for Flight III illustrate. Nevertheless, CBO considers it unlikely that a ship design from the late 1970s and early 1980s would prove robust enough to accommodate changes made to counter threats at sea until the 2070s and 2080s, when the DDG(X)s would be reaching the end of their notional 40-year service life. For example, the Navy has limited ability to improve the stealthiness of the DDG-51 class if it does not redesign the hull. If it does redesign the hull, it will, in effect, have created an entirely new ship. Under those assumptions, CBO projects the average cost of the DDG(X) at $3.3 billion, roughly 65 percent higher than the Navy's projection. CBO's current estimate is slightly lower than its estimate of $3.4 billion under the 2013 plan; that difference is the result of increased production rates for the DDG(X) in

28. As a point of comparison, the Navy's first Flight IIA ship—the DDG-79, which incorporated such changes as a helicopter hangar and a larger displacement—cost about 20 percent more than the DDG-78. The transition from the Flight IIA to Flight III ships is expected to involve more extensive changes than the transition from the Flight I/II to Flight IIA ships.

29. Press reports indicate that some Navy officials do not agree with the DDG-51 Flight III strategy and would prefer to build Flight IIAs a little longer while designing an entirely new destroyer that would allow for greater growth potential in all respects. See Christopher Cavas, "U.S. Navy Weighs Halving LCS Order," *Defense News* (March 17, 2013), http://tinyurl.com/kbey7qp.

30. That retirement date is based on the Navy's assumption that all DDG-51 Flight IIAs will be modernized midway through their service life and will operate for 40 years.

the 2014 plan, which lower overhead costs per ship and also lower direct production costs through greater learning. Over the 2014–2043 period, CBO estimates, the Navy would have to spend $108 billion for this part of its shipbuilding program—$44 billion (or about 70 percent) more than the Navy's estimate of $64 billion.

Littoral Combat Ships

In the 2014 plan, the Navy envisions building a force of 52 small surface combatants called littoral combat ships (LCSs) by 2026. The first LCS was authorized in 2005, and the Navy already has 16 ships either in its fleet or under construction. Because those ships are assumed to have a service life of 25 years, the Navy would need to begin procuring their replacements in 2030. Therefore, the Navy plans to purchase 36 more LCSs through 2026 and 30 next-generation ships, called LCS(X)s, between 2030 and 2043.

The LCS differs from past and present U.S. warships in that its production program is divided into two components—the sea frame (the ship itself) and mission packages (the main combat systems). The sea frame is being designed and built so that mission packages can be switched on a given ship over time as the ship's mission changes. Currently, the Navy expects to use three types of mission packages—one each for countering mines, submarines, and surface ships. It also expects that the LCS will be able to perform maritime security operations while equipped with any of those mission packages. In all, the service plans to buy 64 mission packages for the 52 ships to be purchased by 2026.[31]

The Navy wants the LCS to be cheaper than other surface combatants. Originally, each sea frame was expected to cost, on average, $297 million in 2013 dollars (or $220 million in 2005 dollars, the original goal). The first 4 LCSs, which were purchased between 2005 and 2009, cost more than double that amount and were built by 2 different contractors using different designs. In light of that cost growth, the Navy revised its acquisition strategy for the ships several times. Ultimately, the service organized a competition between the two contractors and received lower-than-expected bids for the ships. As authorized by the Congress in 2010, the service accepted bids to buy 10 ships from each of the contractors, subject to annual appropriations by the Congress. Today, 12 of those 20 LCSs are under construction or are on order, and the remaining 8 will be ordered in 2014 and 2015.[32] Thus, by 2015, the Navy intends to have purchased 12 ships of each LCS design, for a total of 24.

The Navy has not determined its acquisition strategy for the remaining 28 of the 52 ships it intends to purchase through 2026. Notably, the 2014 plan removed the language from the 2013 plan that stated the Navy would keep both designs in production through 2026. In fact, the Navy has several options to consider for the LCS starting in 2016: It could change the number of ships it plans to purchase once it has more experience with the two designs; it could select one design for the remainder of the program or hold another competition that included both designs; or it could end the program altogether if it decided that both designs no longer met its future needs and that a more direct replacement for the Navy's frigates was necessary. For now, the Navy plans to see how well the existing shipyards perform in executing their contracts before it decides whether or how to acquire the rest of the ships.

In the 2014 Future Years Defense Program, the Navy estimated the average cost of the LCS at about $420 million per ship over the next five years, including the 6 ships (2 per year) to be bought in 2016 through 2018, after the end of the two 10-ship contracts. That figure is well below the Congressionally mandated cost cap for the LCS program of $515 million per ship (adjusted for inflation).[33] Overall, the Navy estimated that the 36 LCSs to be purchased by 2026 would cost about $446 million per ship, on average.

The key to the future cost of the littoral combat ships will be how well each shipbuilder can execute its current 10-ship contract. If the shipyards build the ships without

31. Department of the Navy, *Report to Congress: Littoral Combat Ship Mission Packages* (May 2009).

32. For a discussion of issues involved with this request, see Congressional Budget Office, letter to the Honorable John McCain about the cost implications of the Navy's plans for acquiring littoral combat ships (December 10, 2010), www.cbo.gov/publication/21968.

33. The National Defense Authorization Act for Fiscal Year 2010, which set the LCS cost cap to apply to ships purchased in fiscal year 2010 and beyond, gave the Secretary of the Navy authority to waive compliance with the cap if doing so was considered in "the best interest of the United States," if the ship was "affordable, within the context of the annual naval vessel construction plan," or in other specific circumstances.

major delays or cost overruns, which seems to be the case so far, then the Navy could obtain future prices (adjusted for inflation) that are similar to the ones it negotiated in the recent competition. However, if one or both shipyards find it difficult to build the ships for the prices to which they agreed under the 10-ship contracts, then the prices for ships purchased after 2015 would probably be higher. Selecting a single design and one shipyard to build that design would economize on overhead costs but would sacrifice the competitive pressure that could help hold down costs for future ship purchases. By contrast, continuing to purchase two types of the ships would maintain more competitive pressure but at the expense of a lower production rate in each shipyard, thus incurring higher average overhead costs. Another disadvantage of the latter approach is that the Navy would face higher costs to support training and maintenance programs for both of the ship designs.

Since its analysis of the Navy's 2012 plan two years ago, CBO lowered its estimate for the cost of the LCSs purchased between 2010 and 2015 to reflect the contract prices and terms to which the Navy and the two shipyards agreed. However, CBO expects that the Navy will pay slightly higher prices for the ships purchased after 2015, in part because the annual procurement quantities planned for those years are lower than in previous years. Therefore, CBO estimates the average per-ship cost of the 36 LCSs in the plan at about $500 million.

Under the 2014 plan, the Navy would also buy 30 next-generation littoral combat ships—called LCS(X)s—beginning in 2030. The Navy's cost estimate for the LCS(X) is $433 million (or slightly less than the average cost of the original LCS), which is consistent with its estimate in the 2013 plan. In contrast, CBO estimates the average cost of the LCS(X) at about $600 million per ship, which is consistent with its estimate under the 2013 plan.

Amphibious Warfare Ships

The Navy's current goal for amphibious ships is 33, compared with approximately 32 last year. The proposed force would consist of 11 LHA or LHD amphibious assault ships, 11 LPD amphibious transport docks, and 11 replacements for the Navy's LSD dock landing ships. In pursuit of that force, the 2014 plan calls for buying 6 LHA-6s, at a rate of 1 every four or seven years, to replace LHD-1 class amphibious assault ships as they are retired.[34] The plan envisions buying 11 LX(R)s (the designator for the replacement for LSDs), 1 every other year between 2019 and 2027 and then 1 per year until 2033, to replace existing dock landing ships in the LSD-41 and LSD-49 classes. Under the 2014 plan, the LX(R) would enter the fleet beginning one year later than under the 2013 plan. The 2014 plan would also start replacing the LPD-17 class with a new class in the early 2040s, buying 1 ship in 2040 and 1 in 2042. With that procurement schedule, the total number of amphibious warfare ships would be at or above the goal of 33 ships for about half of the 30-year period covered by the plan (see Figure 4 on page 10). One way in which the Navy plans to achieve that force level is to keep the existing class of LHD-1 amphibious assault ships in service for 43 to 45 years; that expectation, which also appeared in the 2013 plan, is an increase relative to the 40-year service life incorporated in the 2012 plan.

The Navy's cost estimates for amphibious warfare ships have not changed significantly since the 2013 plan. In the 2014 plan, the Navy appears to assume that the LX(R) will be about the same size as existing LSDs—that is, with a displacement of about 16,000 tons. Consequently, the Navy estimates the cost of the LX(R) at $1.4 billion per ship. CBO puts the figure at $1.6 billion.

The Navy estimates that the LHA-6 class amphibious assault ships will cost $3.6 billion apiece. CBO's estimate for those ships is higher: an average of $4.3 billion per ship. Both CBO and the Navy assumed that the LHA-6 class ship authorized in 2016 and all subsequent amphibious assault ships would include well decks, necessitating some redesign to the LHA-6 class—and thus additional costs. (Well decks are large floodable areas in the sterns of most amphibious warfare ships that allow amphibious vehicles and craft to be launched directly from the ships.) The cost of that redesign is included in both the Navy's and CBO's estimates.

34. There is a seven-year gap between the ship purchased in 2017 and the next one purchased in 2024. After that, however, the LHA class is purchased at a rate of 1 every four years.

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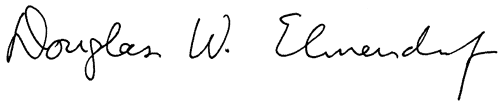
About This Document

The Congressional Budget Office's (CBO's) report *An Analysis of the Navy's Fiscal Year 2014 Shipbuilding Plan*, which was released on October 18, 2013, was prepared as required by the National Defense Authorization Act for Fiscal Year 2012 (Public Law 112-81). In accordance with CBO's mandate to provide objective, impartial analysis, the report makes no recommendations.

Eric J. Labs of CBO's National Security Division prepared the report with guidance from David E. Mosher and Matthew Goldberg. Raymond Hall of CBO's Budget Analysis Division produced the cost estimates with guidance from Sarah Jennings. Derek Trunkey of CBO provided helpful comments on the report, as did Scott Truver of Gryphon Technologies and Tim Colton of Maritime Memos. (The assistance of external reviewers implies no responsibility for the final product, which rests solely with CBO.) Jeanine Rees edited the report and prepared it for publication.

This testimony reprises the report released last week. Electronic versions of both the report and the testimony are available on CBO's Web site (www.cbo.gov/publication/44655 and www.cbo.gov/publication/44660, respectively).



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