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CBO

An Analysis of the Navy's Fiscal Year 2013 Shipbuilding Plan

JULY 2012

Notes

Unless otherwise indicated, all dollar amounts in this report reflect budget authority in 2012 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.

On the cover—

Top left: The Arleigh Burke-class guided-missile destroyer USS *Halsey* (DD 97), front, and the Ticonderoga-class guided-missile cruiser USS *Bunker Hill* (CG 52) underway in formation, June 2, 2012. Photo by Mass Communication Specialist Seaman George M. Bell, U.S. Navy.

Top right: The Nimitz class aircraft carrier USS *Abraham Lincoln* (CVN 72) transits the Arabian Sea, June 2, 2012. Photo by Mass Communication Specialist Seaman Joshua E. Walters, U.S. Navy.

Bottom left: The amphibious transport dock ship USS *Austin* (LPD 4) operates off the coast of Haiti, May 9, 2005. Photo by Photographer's Mate 1st Class Shawn P. Eklund, U.S. Navy.

Bottom right: The Ohio-class ballistic missile submarine USS *Alaska* (SSBN 732) approaches Naval Submarine Base Kings Bay, Georgia, after successfully completing sea trials. Photo by Mass Communication Specialist 1st Class James Kimber, U.S. Navy.

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Summary

At the direction of the Congress, the Department of Defense generally issues annual reports that describe its plan for building new ships over the next 30 years. The latest plan—submitted to the Congress in late March 2012 and covering fiscal years 2013 to 2042—contains some significant changes in the Navy's long-term goals for shipbuilding.[1] In particular, the Navy's latest plan would:

- Reduce the goal for the inventory of ships,
- Reduce the number of ships to be purchased, and
- Alter the composition of ships to be purchased, buying fewer less-expensive support ships and more high-end combat ships.

The total costs of carrying out the 2013 plan—an average of about $22 billion per year in 2012 dollars over the next 30 years—would be much higher than the funding amounts that the Navy has received in recent years and higher than the costs for the 2012 plan, the Congressional Budget Office (CBO) estimates.

Inventory Goals

The Navy's 2013 shipbuilding plan states that the service's current goal for its inventory of battle force ships (aircraft carriers, submarines, surface combatants, amphibious warfare ships, and some logistics and support ships) is "about 300 warships," but the figures for individual categories of ships total 310 to 316 ships. (Navy officials characterize 300 ships as an interim goal until the service completes its new Force Structure Assessment later this year; virtually all ship goals are approximate, and the Navy gives an explicit range for two types of submarines.) Those numbers are down from 328 ships under the 2012 plan and in the same range as the 313 ships the Navy wanted as a result of its 2005 assessment of the desired force structure.[2] The battle force fleet currently numbers 286 ships.

The Navy's shipbuilding plan would fall short of meeting the service's inventory goal for some types of ships. For example, the plan would fail to meet the goal of about 90 large surface combatants (destroyers and cruisers) starting in 2029. The Navy assumes that most of its destroyers will serve for 40 years. In the past, the Navy's large surface combatants have typically served for 30 years or less. If the destroyers serve for only 35 or 30 years, the shortfall in large surface combatants could be more than twice as large as projected under the Navy's plan, unless more ships were purchased.

Purchasing Plan

Under the 2013 plan, the Navy would buy a total of 268 ships over the 2013–2042 period: 222 combat ships and 46 logistics and support ships (see Summary Table 1). Given the rate at which the Navy plans to retire ships from the fleet, that construction plan would be insufficient to achieve a fleet of 310 to 316 ships but would produce a fleet of about 300 ships for most of the next 30 years.

1. The 2013 shipbuilding plan is Department of the Navy, *Annual Report to Congress on Long-Range Plan for Construction of Naval Vessels for FY 2013* (April 2012), www.wired.com/images_blogs/dangerroom/2012/03/navy-shipbuilding-fy2013.pdf.

2. The Navy includes in its reported inventory of battle force ships 5 joint high-speed vessels, or JHSVs, that are being paid for by the Army but operated by the Navy. If those ships are not counted as part of the Navy's inventory objective, then the goal for the 2012 plan would have been 323 ships. In its 2013 plan, the Navy counts the Army JHSVs as part of its battle force, includes their costs, and drops the distinction between those oriented toward Army missions and those oriented toward Navy missions.

Summary Table 1.

Comparison of the Navy's 2012 and 2013 Shipbuilding Plans

	2012 Plan (2012–2041)	2013 Plan (2013–2042)	Change from 2012 to 2013
	Number of Ships Purchased Over 30 Years		
Combat Ships			
Aircraft carriers	6	6	0
Ballistic missile submarines	12	12	0
Attack submarines	44	46	2
Destroyers	52	70	18
Littoral combat ships	71	70 [a]	-1
Amphibious warfare ships	20	18	-2
Subtotal	205	222	17
Combat Logistics and Support Ships	70 [b]	46	-24
Total	**275**	**268**	**-7**
	Costs of New-Ship Construction[c] (Billions of 2012 dollars)		
Total Cost Over 30 Years			
Navy's estimate	481 [d]	505	24
CBO's estimate	557	599	42
Average Annual Cost			
Navy's estimate	16.0 [d]	16.8	0.8
CBO's estimate	18.6	20.0	1.4
Average Cost per Ship			
Navy's estimate	1.8 [d]	1.9	0.1
CBO's estimate	2.1	2.2	0.1

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

a. Under the 2013 plan, the Navy will have 55 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. The Navy's 2012 plan included 5 joint high-speed vessels—small, fast ferries for transporting small numbers of personnel or equipment within a theater of operations—that would be paid for by the Army and used primarily for Army missions, although they would be operated by the Navy. The Navy excluded the costs of those ships from its cost estimates but counted the ships themselves in its procurement and inventory of battle force ships; CBO did the same.

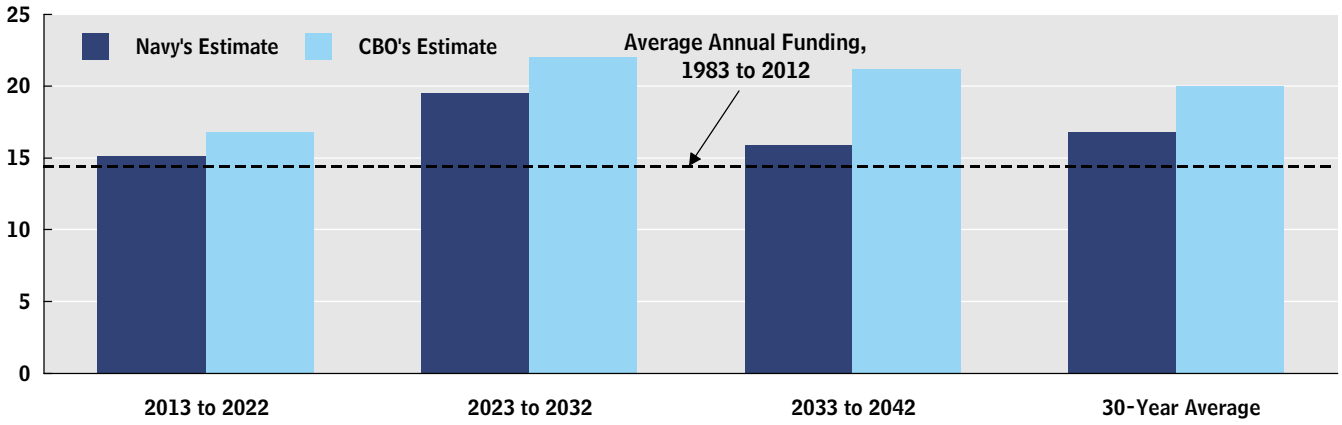
c. Costs of new-ship construction exclude funds for refueling nuclear-powered aircraft carriers. They also exclude funds for ship conversions, construction of ships that are not part of the Navy's battle force (such as oceanographic survey ships), training ships, outfitting and postdelivery costs (which 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.

d. CBO adjusted the Navy's estimate in the 2012 plan to reflect the service's official cost estimate for the SSBN(X) ballistic missile submarine, as provided by the SSBN(X) program office, which makes it easier to compare the 2012 estimate with the one in the 2013 plan.

Summary Figure 1.

Average Annual Costs of New-Ship Construction Under the Navy's 2013 Plan

(Billions of 2012 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.

In comparison, in the 2012 shipbuilding plan, the Navy envisioned buying 205 (or 17 fewer) combat ships and 70 (or 24 more) logistics and support ships between 2012 and 2041, for a total of 275. That plan was insufficient to achieve a fleet of 328 ships, the goal in the 2012 plan.

Costs

The Navy estimates that buying the new ships in the 2013 plan will cost a total of $505 billion over 30 years—about 5 percent more than its estimate for the 2012 plan—or an average of $16.8 billion per year (see Summary Figure 1). (Unless otherwise indicated, all dollar amounts in this report reflect budget authority in 2012 dollars. Budget authority is the amount of money authorized by the Congress that government agencies can spend on goods and services.) 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 or delivered—will, in CBO's estimation, add about $2 billion to the Navy's average annual shipbuilding costs under the 2013 plan, bringing the average annual cost to $18.8 billion.

Using its own models and assumptions, CBO estimates that the cost for new-ship construction under the 2013 plan will total $599 billion through 2042, or an average of $20.0 billion per year.[3] Including the roughly $2 billion average annual expense of refueling aircraft carriers and of other items such as outfitting new ships raises that average to $21.9 billion per year, CBO estimates. Those figures are about $42 billion, or 8 percent, more than CBO's estimates of the Navy's 2012 plan.

CBO's estimate of the costs for new-ship construction in the 2013 shipbuilding plan is about $94 billion, or 19 percent, higher than the Navy's estimate overall.

3. Generally, CBO estimates the price of future naval vessels on the basis of the relationship between cost and weight of analogous ships. The estimated cost per ship 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 costs of labor and materials in the naval shipbuilding industry have generally risen faster than have costs in the economy as a whole.

CBO's estimates are 11 percent higher than the Navy's for the first 10 years of the plan, 13 percent higher for the following decade, and 33 percent higher for the final 10 years of the plan. Two factors explain most of the differences between the two estimates. First, the Navy and CBO used different estimating methods and assumptions about the designs and capabilities of future ships. Second, CBO 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, whereas the Navy does not appear to have done so; that factor produces a widening gap between the estimates over time.

Costs of the Plan Compared with Historical Funding

If the Navy receives the same amount of funding for new-ship construction in each of the next 30 years as it has on average over the past three decades—$14.3 billion annually—it will not be able to afford all of the purchases in the 2013 plan.[4] CBO's estimate of $20.0 billion per year for new-ship construction in the Navy's 2013 shipbuilding plan is about 40 percent above the historical average funding (see Summary Figure 1 on page v). CBO's estimate of $21.9 billion per year for the full cost of the Navy's shipbuilding program is about 37 percent higher than the $16.0 billion the Navy has spent each year on average for all items in its shipbuilding accounts over the past 30 years.

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).

An Analysis of the Navy's Fiscal Year 2013 Shipbuilding Plan

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.[1] A few months later, the Congressional Budget Office (CBO) issued a study analyzing that plan and estimating its potential costs. Every year since then, CBO has performed an independent analysis of the Navy's latest shipbuilding plan.

Through 2011, at the direction of the Congress, the Department of the Navy issued annual reports that described its plans for ship construction over the coming 30 years.[2] But in the Ike Skelton National Defense Authorization Act for Fiscal Year 2011 (Public Law 111-383), the Congress relieved the Navy of that requirement except when the Department of Defense (DoD) submits the Quadrennial Defense Review. Thus, no report for 2012 was issued, but at the request of the House Armed Services Committee, the Navy provided briefing slides and tables showing a 30-year schedule that made a number of adjustments to the schedule released one year earlier. CBO analyzed those materials, treating them as a modification to the Navy's 2011 30-year shipbuilding plan. Now, with the passage of the National Defense Authorization Act for Fiscal Year 2012 (P.L. 112-81), the Congress has reinstated the requirement of an annual report from the Department of Defense on its long-range plans for shipbuilding.

The 2012 and 2013 plans are 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 funding to implement the plans. In response to a mandate in the 2012 defense authorization act, CBO examined the 2013 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.

Changes in Inventory Goals Under the 2013 Plan

The 2013 plan, which the Deputy Secretary of Defense submitted to the Congress on March 28, 2012, described the Navy's fleet as needing "about 300 warships," which is below the 313-ship goal articulated in the fiscal year 2007 plan and the 328-ship goal implied in the fiscal year 2012 plan. The 2013 plan also described changes to the inventory goals of most categories of ships that would ultimately reduce the goal for battle force ships to a range of 310 to 316.[3] (Box 1 discusses the major ships in the Navy's fleet and the roles they play.) However, Navy officials characterize that range as an interim goal until the Navy completes its new Force Structure Assessment later this year. Specifically, the goals in the Navy's 2013 plan described a range for two types of submarines and characterized virtually all ship goals as approximate.

1. Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2007* (February 2006). Battle force ships comprise aircraft carriers, submarines, surface combatants, amphibious warfare ships, and some logistics and support ships.

2. The 2013 shipbuilding plan is Department of the Navy, *Annual Report to Congress on Long-Range Plan for Construction of Naval Vessels for FY 2013* (April 2012), www.wired.com/images_blogs/dangerroom/2012/03/navy-shipbuilding-fy2013.pdf.

3. For a detailed discussion of the changes in the Navy's shipbuilding goals from a fleet of 313 ships to a fleet of 328, see Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2012 Shipbuilding Plan* (June 2011).

Box 1.

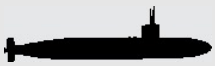
The Roles of Major Types of Ships in the Navy's Battle Force Fleet

Nimitz Class
Aircraft Carrier

The Navy's 11 **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. Ten of the 11 current carriers belong to the Nimitz class.

Ohio Class Ballistic
Missile Submarine

Strategic **ballistic missile submarines** carry the major part of the U.S. nuclear deterrent, up to 24 Trident missiles with four to eight nuclear warheads apiece. The Navy has 14 Ohio class ballistic missile submarines in the strategic role and has converted 4 more to a conventional guided missile (SSGN) configuration, each of which displaces about 19,000 tons 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 53 attack submarines, 44 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 are 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.

The changes in the Navy's inventory goals for battle force ships are as follows:

- The number of ballistic missile submarines was changed from 12 to a range of 12 to 14 (see Table 1).
- The number of guided missile submarines was changed from 0 to a range of 0 to 4.
- The number of large surface combatants was lowered from 94 to approximately 90.[4]
- The number of amphibious warfare ships was decreased from 33 to approximately 32.
- The number of combat logistics ships was reduced from 30 to approximately 29. Specifically, the number of oilers was reduced from 19 to 17, and the number of T-AKE supply ships was increased from 11 to 12.[5]
- The number of support ships was lowered from 45 to approximately 33. Specifically, the planned number of joint high-speed vessels (JHSVs)—small, fast ferries for transporting small numbers of personnel or equipment within a theater of operations—was reduced from 21 to 10 ships.[6] The number of T-AGOS ocean surveillance ships was decreased from 6 to 5. The number of mobile landing platforms was increased from 3 to 4, and 2 of them are being designed as "afloat forward staging bases," which means they would stay in an area of operations for a long period of time to provide logistics support to other military forces as needed.

Table 1.

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 Plan	
		2012	2013
Aircraft Carriers	11	11	11
Submarines			
Ballistic missile	14	12	12 to 14
Attack	48	48	~48
Guided missile	4	0	0 to 4
Large Surface Combatants			
Destroyers	69	94	~90
Cruisers	19	0	0
Small Surface Combatants and Mine Countermeasures Ships[a]	55	55	~55
Amphibious Warfare Ships	31	33	~32
MPF(F) Ships	12	0	0
Combat Logistics Ships	30	30	~29
Support Ships			
Joint high-speed vessels	3	21[b]	10[b]
Other[c]	17	24	~23
Total	**313**	**328**[b]	**~310 to 316**[d]

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. The Navy's goal in the 2012 plan was 21 joint high-speed vessels. That number included 5 ships that would be used to fulfill, at least in part, the Army's missions but that the Navy would operate and include in its battle force inventory. If the 5 Army ships were excluded from the Navy's force-structure goals, the inventory goal in the 2012 plan would have been 323 ships. In the 2013 plan, the Navy lowered the goal to 10 ships for all Navy and Army missions.

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

d. The Navy describes its total goal as about 300 ships, but the specific numbers included in the 2013 plan imply a range of 310 to 316 ships.

4. This change appears to back away from the inventory objective established in a 2011 report to the Congress. See Director of Strategy and Policy (N51), Office of the Chief of Naval Operations, *Report to Congress on Naval Force Structure and Missile Defense* (April 2011), pp. 4 and 6. Specifically, the report states: "The analytical work associated with the Navy's ongoing Force Structure Analysis has progressed to the point that a FY2024 requirement for 94 multi-mission large surface combatants has been established."

5. A T-AKE was shifted from the support ships category to the combat logistics ships category in the 2013 plan.

6. A force of 21 JHSVs was implied by the ship purchases in the 2012 plan: 16 for Navy missions and 5 for Army missions. The 5 JHSVs for Army missions are being paid for by the Army and operated by the Navy and were counted as part of the Navy's battle force ships. The Navy has since reduced its goals for JHSVs from 21 to 10: 5 for Navy missions and 5 for Army missions, although the ships designated for Army missions would also be available some of the time to perform Navy missions.

Taken together, those changes effectively produce a goal of 310 to 316 ships for the battle force fleet. The Navy's full 2011 shipbuilding report also stated that the Navy planned to conduct a new analysis of its force structure to officially determine its future inventory goal; that assessment is still under way and has not yet been released. The Navy stated in its 2013 plan that the results of that force-structure assessment could change the inventory goals outlined in the plan. (The most recent assessment was conducted in 2005, and its results led to the goal of 313 ships.) This CBO report does not evaluate the goals identified by the Navy; rather, it assesses the costs of the Navy's 2013 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 2013 Plan

The Navy intends to buy 10 ships in 2013 (see Figures 1 and 2 on pages 6 and 7) and a total of 41 ships during the five-year period of 2013 through 2017 (the period covered by DoD's current Future Years Defense Program, or FYDP—a five-year funding plan that DoD updates annually). Thereafter, the Navy would buy an additional 227 vessels through 2042—for a total of 268 ships over 30 years, or an average of 8.9 per year. The pace of shipbuilding would be faster on average in the near term than later on: The Navy plans to purchase an average of 9.3 ships annually between 2013 and 2022; production of littoral combat ships—small surface combatants designed to operate in coastal waters—would increase to 3 or 4 per year for most years in that decade.

If implemented as described above, the 2013 plan would never achieve a force of 310 to 316 ships between now and 2042 (see the bottom panel of Figure 1). The force would comprise approximately 300 ships (defined by CBO as 295 ships or more) by 2019 and beyond but would fall short of the Navy's specific goals in several ship categories.

Altogether, the Navy would buy almost the same number of ships over 30 years under the 2013 plan as it would have bought under the previous plan.[7] However, the composition of ship purchases—particularly the mix of combat ships and logistics and support vessels—is quite different under the 2012 and 2013 plans.

Combat Ships

Under the 2013 plan, the Navy envisions buying 222 combat ships—aircraft carriers, submarines, large and small surface combatants, and amphibious warfare ships—between 2013 and 2042. That total is 17 ships more than under the 2012 plan. Those purchases would still leave the Navy short of its inventory objectives for attack submarines, large surface combatants, and amphibious warfare ships for significant parts of the 2013–2042 period, although those shortfalls are now less pronounced than they would have been under the 2012 plan. For aircraft carriers, by contrast, the Navy would meet or exceed its goal of 11 ships throughout the 2013–2042 time frame, except for the periods from 2013 to 2015 and from 2040 to 2042. With respect to small surface combatants, the Navy plans to replace its frigates and mine countermeasures ships with littoral combat ships; it would not reach its objective of having 55 such ships in the fleet until 2029, although that would be six years earlier than under the 2012 plan.

Ballistic Missile Submarines. The current shipbuilding plan delays buying the first replacement for the Ohio class ballistic missile submarines [SSBN(X)s] by two years, until 2021; it would then enter the fleet in 2030. As a consequence, the Navy's inventory of SSBNs will fall below the stated goal of 12 to 14 between 2029 and 2041 (see Figure 3 on page 8). The Navy still plans to purchase 12 SSBN(X)s, but the retirement of Ohio class submarines as they reach the end of the 42-year service life on the same schedule as under the 2012 plan means a shortfall of 1 or 2 submarines in the inventory goal during those years.

Attack Submarines. Under the 2013 plan, the Navy would purchase 46 attack submarines through 2042, 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 2021 to a low of 43 from 2028 to 2030 and then increase to about 48 or more after 2035. The reason for the decline is that, in 2014, the Navy expects to begin retiring Los Angeles class attack submarines (SSN-688s)—which

7. The change in the time frame covered by the two plans—2012 to 2041 versus 2013 to 2042—accounts for a difference of 3 ships. The 2012 plan called for buying 11 ships in 2012 (as adjusted for appropriations by the Congress to buy 11 ships in 2012 rather than the 10 requested by the Department of the Navy), whereas the 2013 plan includes the purchase of 8 ships in 2042.

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. It would then replace them with Virginia class attack submarines (SSN-774s) and their successors, mostly at rates of 1 or 2 per year.

Large Surface Combatants. The current shipbuilding plan calls for buying 70 destroyers based on the existing Arleigh Burke class destroyer (DDG-51) design. Those purchases would allow the Navy's inventory of large surface combatants to meet the goal of approximately 90 ships (defined by CBO as 88 or more) for 11 years over the next 30. Specifically, it would meet that goal for seven years in the mid-2020s, then would fall to a low of 78 in 2034 before increasing back to the high-80s by 2039. 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 early 2020s (after retiring 7 cruisers early in 2013 and 2014) and DDG-51s in the late 2020s at a faster pace than their replacements would be commissioned. By adding 18 destroyers to the 2013 plan, the Navy has significantly reduced the shortfall it faced in those ships under the 2012 plan.

The assumptions about the service life of large surface combatants remain the same under the 2013 plan. The 2012 plan assumed that all Arleigh Burke class destroyers commissioned after 2000 would have a service life of 40 years; earlier versions of the ship would remain in the fleet for 35 years.

Amphibious Warfare Ships. The current long-term plan calls for buying 18 amphibious warfare ships through 2042, which would increase the amphibious force from 29 ships today to the current goal of approximately 32 (defined by CBO as 31 or more) by 2018. The force would stay at that size or greater through 2042. The Navy assumed it would keep its LHD class amphibious assault ships for 43 to 45 years (up from 40 years under the 2012 plan). Lengthening the service life of the LHDs and reducing the inventory goal by 1 ship effectively eliminates the long-term shortfall that existed under the 2012 plan. Under that plan, the Navy would have purchased 20 amphibious warfare ships over three decades; given those purchases, the Navy would have met its inventory goal starting in 2017 but would then have dropped below that objective in 2035.

Combat Logistics and Support Ships

In its 2013 plan, the Navy envisions buying 46 logistics and support ships in the next three decades—19 fewer than in the 2012 plan, or a decrease of about 30 percent. Those planned purchases include 1 joint high-speed vessel in 2013, 10 replacement JHSVs in the 2030s, and 17 new oilers over the 30-year period (the latter provide fuel and a few other supplies to ships at sea).

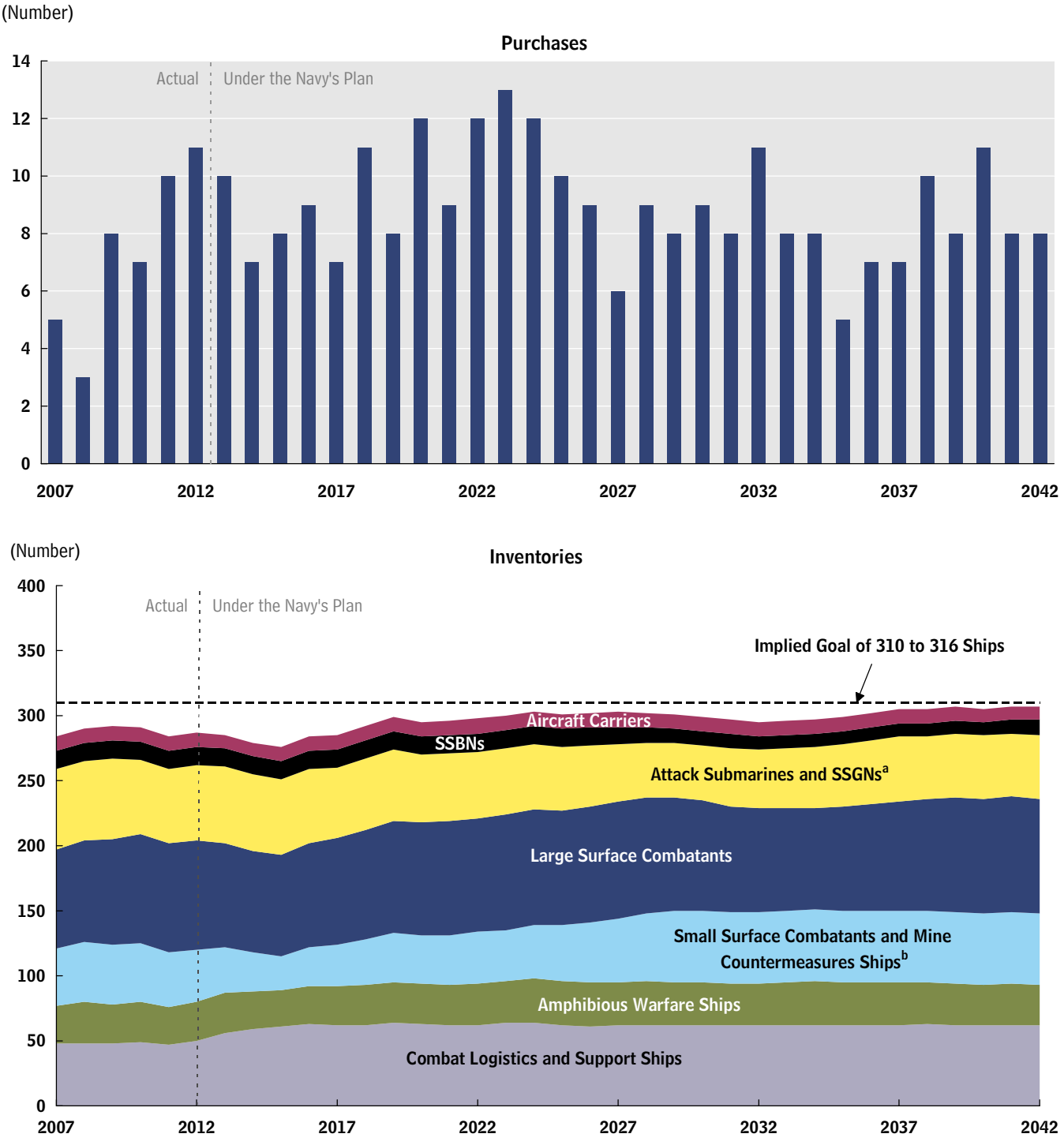
According to the Navy, although the JHSVs are in great demand by regional combatant commanders, the Military Sealift Command (MSC) will operate them with civilian mariners. That arrangement will allow the JHSVs to spend much more time at sea than if they were operated by the regular Navy, which reduces the number of ships that the Navy needs to have in its inventory to meet a given level of operational demand. (The MSC provides strategic sealift and carries out special missions for the Department of Defense, including supply and logistic support to the Navy's fleet.) The 2013 plan implies a new goal of 10 JHSVs (including the 5 ships designated primarily for Army missions), compared with 21 previously. (Purchases under the 2013 plan would exceed the new inventory goal because the JHSVs are expected to have a service life of only 20 years, meaning that the Navy would need to begin buying replacements in 2029.) Once the initial inventory of JHSVs was completed in 2017, the Navy would meet its implied inventory goals for logistics and support ships through the end of the 30-year period.

The Navy reduced the number of T-AO(X) oilers it planned to purchase from 19 to 17 and moved construction of the first ship to 2016, two years later than under the 2012 plan. The Navy's 2013 plan did not explain why the number of oilers was reduced. 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. The oilers would be bought at a rate of 1 per year through the 2020s; the program would conclude in 2034.

Unlike the Navy's 2012 plan, the 2013 plan also included the purchase of replacements for its 2 command ships in the early 2030s. Those ships are scheduled to retire in 2039.

Figure 1.

Annual Ship Purchases and Inventories Under the Navy's 2013 Plan



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

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

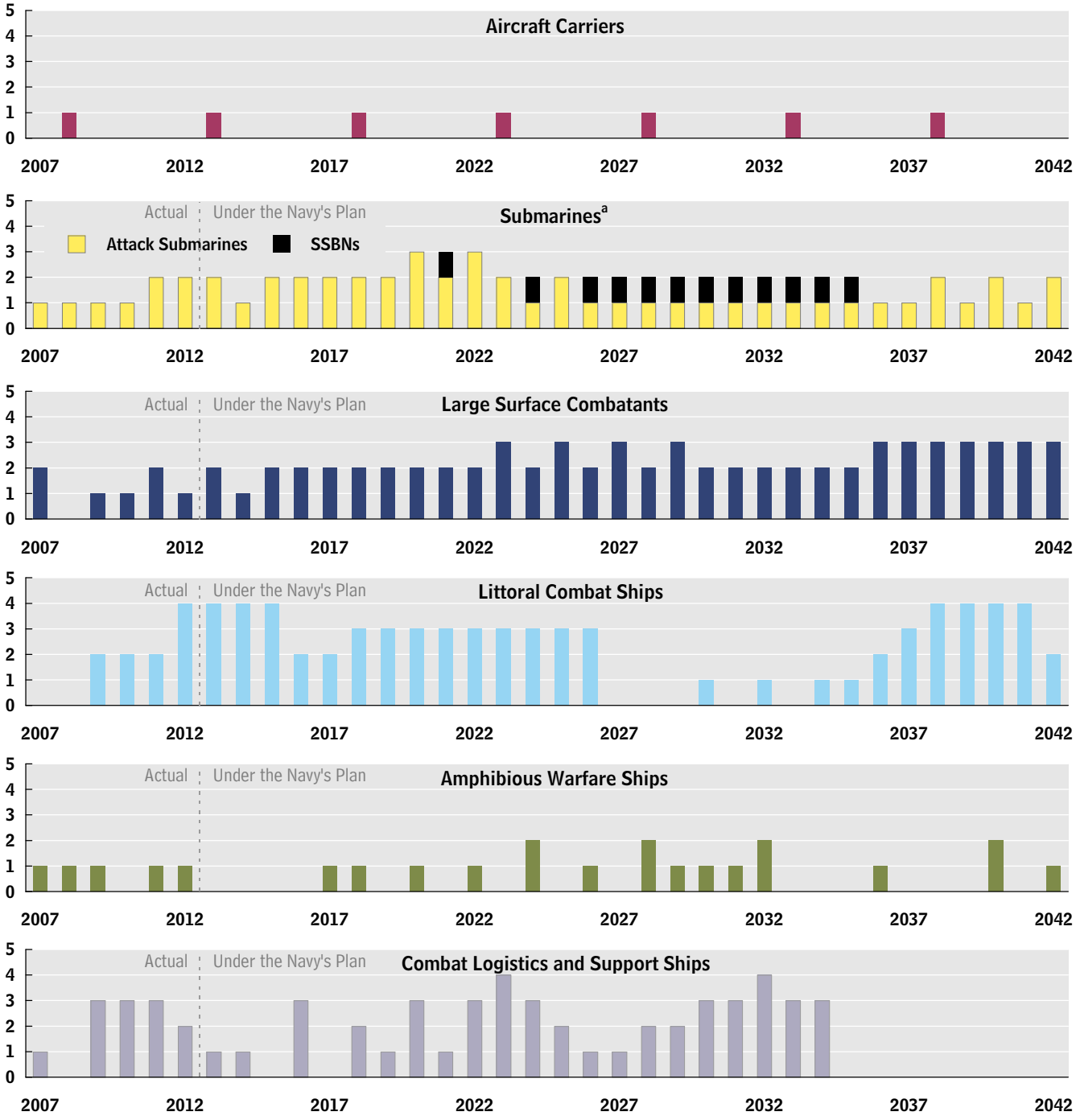
a. Although the Navy does not plan to build more SSGNs, 4 will be in service through the mid-2020s.

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

Figure 2.

Annual Ship Purchases, by Category, Under the Navy's 2013 Plan

(Number)



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

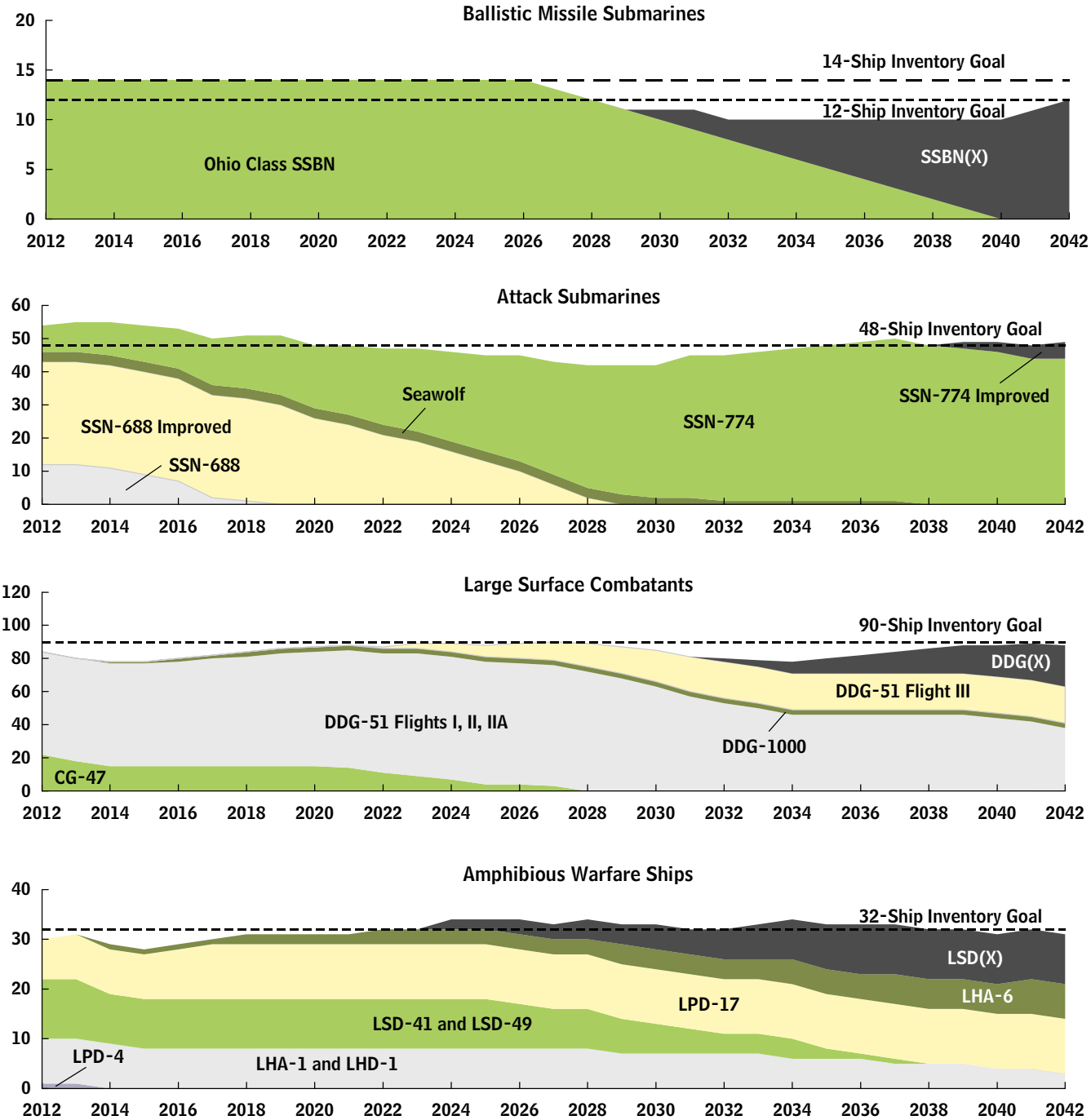
Note: SSBNs = ballistic missile submarines.

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

Figure 3.

Annual Inventories Versus Goals for Selected Categories of Ships Under the Navy's 2013 Plan

(Number)



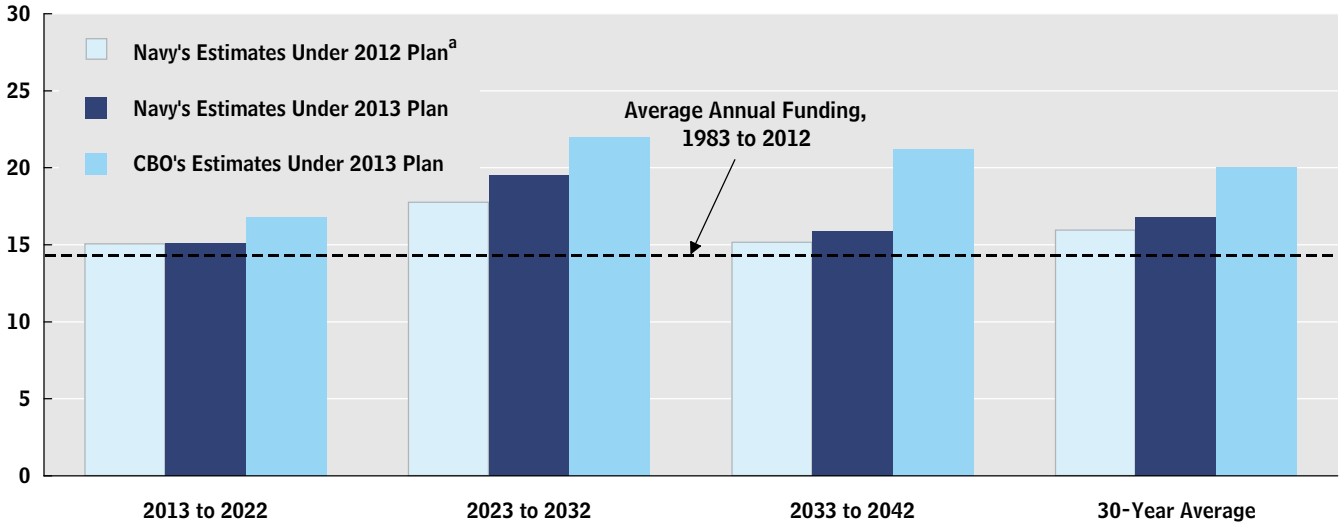
Source: Congressional Budget Office based on data from the Department of the Navy.

Note: SSBN = ballistic missile submarine; SSN = attack submarine; DDG = guided missile destroyer; CG = guided missile cruiser; LSD = dock landing ship; LHA and LHD = amphibious assault ships; LPD = amphibious transport dock.

Figure 4.

Average Annual Costs of New-Ship Construction Under the Navy's 2012 and 2013 Plans

(Billions of 2012 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.

a. The Navy's estimates under the 2012 plan refer to the years 2012 to 2021, 2022 to 2031, 2032 to 2041, and 2012 to 2041.

Ship Costs Under the 2013 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 2042—5 percent more than the $16.0 billion average under its 2012 plan (in 2012 dollars). In making its estimates, the Navy divided the time frame of the 2013 plan into three periods: the near term (2013 to 2022), the midterm (2023 to 2032), and the far term (2033 to 2042). CBO also estimated the costs of the 2013 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 $3.2 billion per year, or 19 percent, higher than the Navy's, but the differences are smaller for the near term and midterm and much larger for the far term (see Figure 4). 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 about 17 percent above the Navy's corresponding figures.[8]

The Navy's Estimates

The text of the Navy's shipbuilding report offers a frank discussion of the difficulties in estimating the capabilities that the Navy might 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 this period are based on our most accurate understanding of required combat capabilities, future defense budget toplines, and shipbuilding costs. The cost estimates for

8. 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.

this period are therefore the most accurate of the three planning periods." For the midterm, "the accuracy of plan cost estimates diminishes for the force structure estimates in this timeframe." 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 ship and cost projections in this period are much more speculative."[9]

New-Ship Construction Costs. According to this year's plan, in the near term, building new ships will cost an average of $15.1 billion per year (see Table 2). That number, however, excludes about $1 billion in cost-to-complete funding to pay for cost overruns for ships that were funded before 2013 but that will require additional funds to be paid out in 2013, 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 $19.5 billion per year. In the far term, the Navy's estimated costs fall to an average of $15.9 billion. As the Navy acknowledges, the precision of those estimates diminishes as the time spans go farther into the future.

Although the Navy's shipbuilding plan suggests that the middle decade will be its most challenging fiscal period, the latter half of the 2013–2022 period (the near term) would require shipbuilding budgets that were almost as large as those in the midterm. According to the Navy's estimates, the average budget for new-ship construction rises from $11.8 billion per year for the 2013–2017 period to $18.5 billion per year for the 2018–2022 period and then to $19.5 billion per year for the following decade (see Figure 5 on page 12).

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

- Refueling of nuclear-powered aircraft carriers, whose reactors are replaced midway through the ships' service life; 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. Over the past 15 years, outfitting and postdelivery costs, which represent the largest amount in this category, have equaled about 3.2 percent of the Navy's total budget for new construction and the refueling of submarines and aircraft carriers.

Including the costs of refueling carriers, as estimated by CBO, would increase the Navy's budget estimate for the 2013 plan to an average of $17.9 billion a year through 2042.[10] Adding the $1 billion in cost-to-complete funding that will be spent in 2013 to 2015 and the annual funding for all other items would boost the full cost of the 2013 shipbuilding plan to $18.8 billion per year. That figure is about 18 percent higher than the average funding for total shipbuilding the Navy has received in the past three decades—about $16 billion per year.

CBO's Estimates

The full annual cost of the 2013 shipbuilding plan, in CBO's estimation, would average $21.9 billion over the 2013–2042 period—about 17 percent more than the Navy's estimate of $18.8 billion and about 37 percent more than the average funding the Navy has received in the past three decades. CBO's numbers are only about 9 percent higher than the Navy's for the first 10 years of the plan but are 30 percent higher for the last 10 years. The full costs exhibit a fair amount of variation year by year but trend upward for the first two decades of the plan (see Figure 6 on page 13). Looking at the 30-year period as a whole and adding up the various cost components, CBO estimated that:

- Costs for new-ship construction alone would average $20.0 billion per year, 19 percent more than the Navy's figure of $16.8 billion (see Table 2).

9. Department of the Navy, *Annual Report to Congress on Long-Range Plan for Construction of Naval Vessels for FY 2013* (April 2012), pp. 12–13, www.wired.com/images_blogs/dangerroom/2012/03/navy-shipbuilding-fy2013.pdf.

10. That number represents the Navy's estimate for new construction plus CBO's estimate for refueling aircraft carriers. In 2010, the Navy transferred funding for refueling nuclear-powered submarines to other accounts (Other Procurement, Navy; Operations 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 2.

Average Annual Shipbuilding Costs Under the Navy's 2013 Plan, by Decade

	Near Term (2013–2022)	Midterm (2023–2032)	Far Term (2033–2042)	Total (2013–2042)
	Navy's Estimates (Billions of 2012 dollars)			
New-Ship Construction	15.1	19.5	15.9	16.8
New-Ship Construction and Refueling of Nuclear-Powered Aircraft Carriers[a]	16.5	20.6	16.7	17.9
New-Ship Construction, Refueling of Nuclear-Powered Aircraft Carriers, and Other Items[b]	17.5	21.6	17.4	18.8
	CBO's Estimates (Billions of 2012 dollars)			
New-Ship Construction	16.8	22.0	21.2	20.0
New-Ship Construction and Refueling of Nuclear-Powered Aircraft Carriers	18.2	23.1	21.9	21.1
New-Ship Construction, Refueling of Nuclear-Powered Aircraft Carriers, and Other Items	19.1	24.0	22.6	21.9
	Percentage Difference Between Navy's and CBO's and Estimates			
New-Ship Construction	11	13	33	19
New-Ship Construction and Refueling of Nuclear-Powered Aircraft Carriers	10	12	31	18
New-Ship Construction, Refueling of Nuclear-Powered Aircraft Carriers, and Other Items	9	11	30	17
Memorandum (Billions of 2012 dollars):				
CBO's Estimates of the Cost to Fully Fund the Navy's Goal of a Fleet of 310 to 316 Ships[c]	18.4	21.8	19.6	19.9
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 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.

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

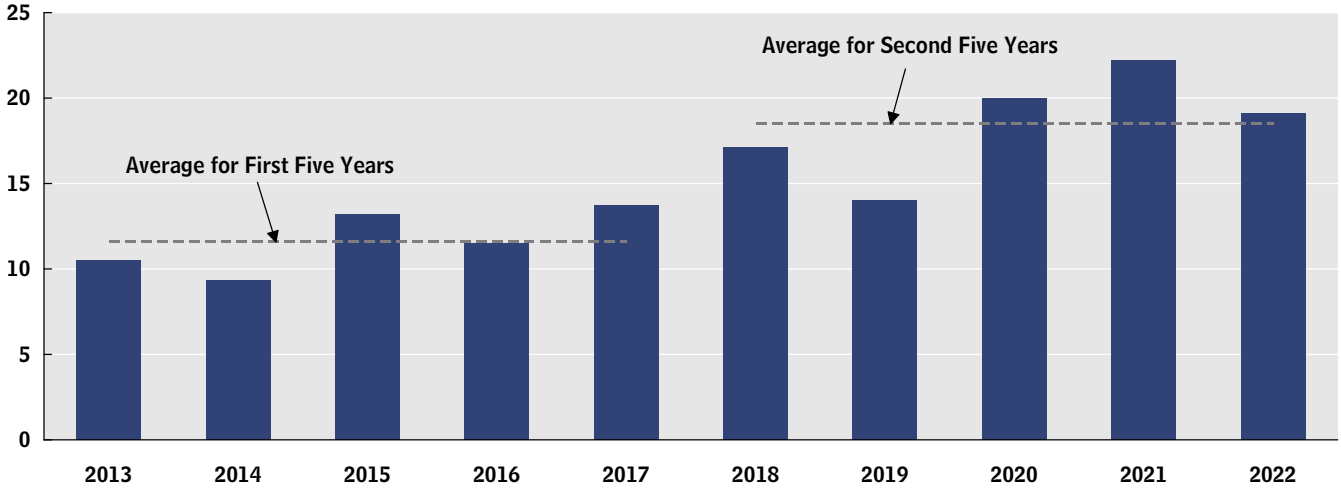
b. These numbers represent the Navy's estimate for new-ship construction, its estimates for cost-to-complete funding for ships purchased in prior years, and CBO's estimates for the refueling of nuclear-powered aircraft carriers and other items.

c. Includes new-ship construction only.

Figure 5.

The Navy's Estimates of New-Ship Construction, 2013 to 2022

(Billions of 2012 dollars)



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

- New-ship construction plus refueling of nuclear-powered aircraft carriers would cost an average of $21.1 billion per year, 18 percent more than the Navy's figure of $17.9 billion.

- All other items would add annual costs of about $900 million, raising CBO's estimate to an average of $21.9 billion per year through 2042, 17 percent greater than the Navy's figure of $18.8 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 mid- and far term, 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 assumed that costs for labor and materials would continue to grow faster in the shipbuilding industry than in the economy as a whole, as they have for the past several decades, whereas the Navy does not appear to have accounted for the higher growth rates (see Box 2 on page 14). That difference is much more pronounced in the last decade of the plan, after 20 or more years of compounded inflation, than in the early years.

Costs of Fully Funding a Fleet of 310 to 316 Ships

Under its 2013 shipbuilding plan, the Navy would not build the appropriate number of ships at the right times to meet the service's inventory goal of 310 to 316 ships. In particular, the plan would lead to shortfalls relative to the Navy's goals for ballistic missile submarines, attack submarines, and large surface combatants. By lowering its inventory goal for amphibious ships from 33 to approximately 32, the shortfall in amphibious warfare ships in previous plans was largely eliminated in the 2013 plan (see Figure 3 on page 8).

The shortfalls could be avoided or reduced by lowering the inventory goals for the various types of ships in its 2013 plan. However, to meet those goals, the Navy could make several changes to the current plan:

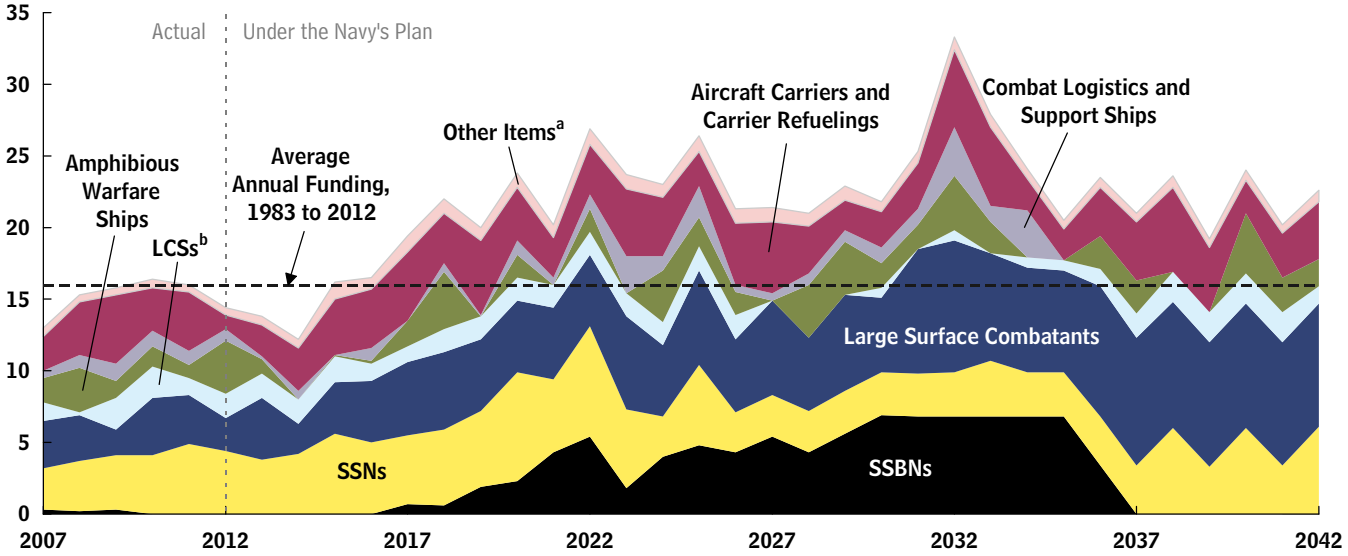
- To prevent the ballistic missile submarine force from falling below the inventory goal of at least 12 submarines, the Navy could begin purchasing the SSBN(X) in 2019, as under the 2012 plan, rather than in 2021 as under the current plan.

- To prevent the attack submarine force from falling below the inventory goal of approximately 48, the Navy could purchase a total of 5 submarines earlier in the 30-year plan and reduce construction of attack submarines later in the plan. Specifically, it could

Figure 6.

CBO's Estimates of Annual Shipbuilding Costs Under the Navy's 2013 Plan

(Billions of 2012 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.

purchase 5 additional attack submarines from 2014 through 2023, increasing the production rate to 3 submarines per year for many of those years. If that increase occurred, the Navy could buy 5 fewer attack submarines between 2025 and 2034 than is called for under its current plan and still maintain the desired inventory level.

- To maintain its planned force of approximately 90 large surface combatants, the Navy could purchase 11 additional destroyers between 2018 and 2028, increasing the production rate to 3 or 4 ships per year. If that increase occurred, the Navy could buy 7 fewer destroyers between 2036 and 2042 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 2013 plan would be to not retire amphibious ships. Because those ships take four to five years to build, construction of additional ships would not solve the shortfall over the next five years. The Navy would meet its inventory goal of approximately 32 ships after 2017.

According to CBO's estimates, incorporating those changes into the Navy's plan would cost more in the first decade of the plan, about the same in the middle decade, and substantially less in the last decade. New-ship construction would average $18.4 billion between 2013 and 2022 (instead of $16.8 billion), $21.8 billion between 2023 and 2032 (instead of $22.0 billion), and $19.6 billion between 2033 and 2042 (instead of $21.2 billion). Over the entire 30-year period, new-ship construction would average $19.9 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.[11]

11. 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.

Inflation in Shipbuilding

An important factor affecting the Navy's and the Congressional Budget Office's (CBO's) estimates is assumptions about future increases in the cost of building naval ships. The Department of Defense (DoD) has an overall estimate of future inflation (known as an inflator) that it uses to project increases in the costs of its procurement programs. However, according to the Navy, DoD's inflator is lower than the actual inflation that occurred in the naval shipbuilding industry in the past decade. The Navy provided CBO with a historical shipbuilding index for 1960 through 2011 that incorporates the growth in the costs of labor and materials that the industry has experienced in the past. To project ship inflation for 2012 through 2018, the service extrapolated from that historical experience, using a weighted composite of annual percentage changes in the costs of labor and materials specific to shipbuilding. Those data are based on information provided by the shipyards about labor costs in the past, as well as on advance pricing agreements, vendor surveys, and projections of the cost of materials from the Bureau of Labor Statistics.

From 2012 through 2018, the Navy projects, the index will grow at an average annual rate of 2.9 percent. By comparison, the gross domestic product (GDP) price index, which measures the prices of all final goods and services in the economy, will grow at an average annual rate of 1.6 percent between 2012 and 2018, in CBO's estimation. The difference between the two rates implies that annual inflation will be 1.3 percentage points higher for shipbuilding programs during that period than for the economy as a whole. That represents a narrowing of the gap that existed when CBO published its analysis of the Navy's 2012 plan, in June 2011, when the difference was 1.5 percentage points. Since 1981, the gap has averaged about 1.4 percentage points (see the figure to the right).

The Navy incorporated that higher rate of shipbuilding inflation (2.9 percent) into its budget request for 2013 and into the associated Future Years Defense Program, which are in nominal dollars. But in projecting the constant-dollar costs for the 2013 shipbuilding plan, the Navy did not assume that the higher inflation rate would drive the costs of future shipbuilding programs. Instead, the 2013 shipbuilding plan assumed that, in constant dollars, a ship that cost $2.5 billion to build in 2012 would cost the same (in 2012 dollars) to build in 2030 or 2040.

In contrast, CBO assumed in its estimates that a higher inflation rate for shipbuilding would continue for the next 30 years—partly because price growth in the shipbuilding industry has exceeded general inflation for most of the past three decades and partly because CBO lacked an analytic basis for determining when and how the difference between the two growth rates would disappear. CBO assumed that shipbuilding inflation would outpace inflation as measured by the GDP price index by 1.3 percentage points between 2012 and 2018 and by 1.4 percentage points—the 30-year historical average—thereafter. Thus, CBO estimated that a ship costing $2.5 billion to build in 2012 would cost $3.1 billion (in 2012 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.

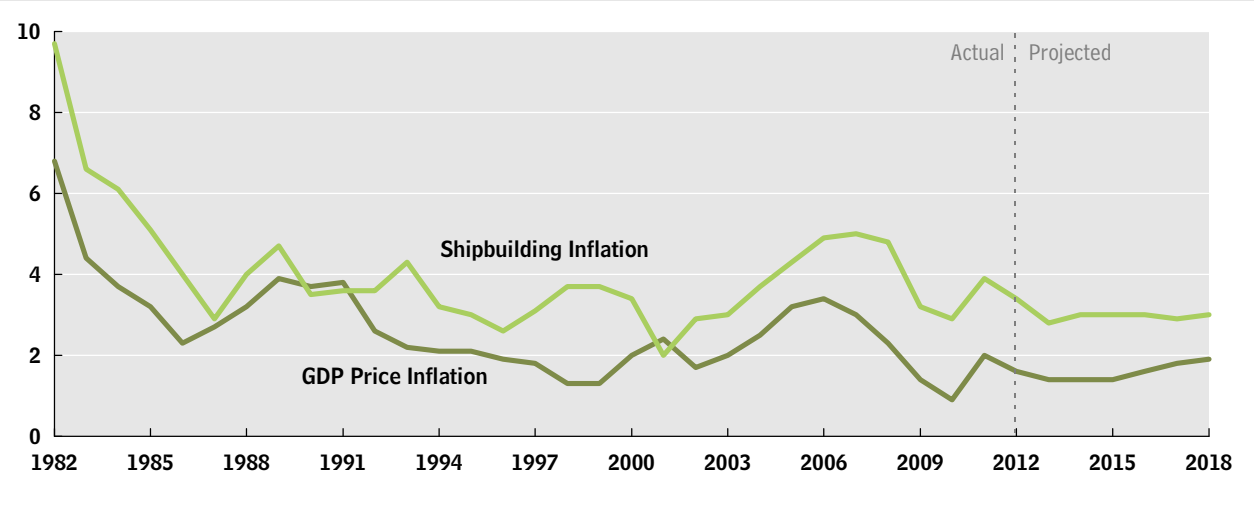
Continued

Other approaches to forestalling shortfalls in the inventory goal of 310 to 316 ships implied by the Navy's 2013 plan could have different costs. For example, if the Navy was able to extend the service life of some existing ships, it would need fewer additional ships, and costs would probably be lower. However, the Navy's plan already assumes that most destroyers will be in service for 40 years, longer than any surface combatant has served in the Navy's fleet in at least the past 30 years. Consequently, CBO did not assume that those ships could be made to serve for an even longer period to prevent the shortfall in large surface combatants.

Box 2. **Continued**

Inflation in Shipbuilding

Annual Rates of Shipbuilding Inflation and GDP Price Inflation



Sources: Congressional Budget Office; Department of the Navy.

Note: GDP = gross domestic product.

Outlook for Specific Ship Programs

To estimate the costs of implementing the Navy's plan, CBO calculated the cost of each of the 268 ships that the Navy intends to purchase from 2013 through 2042. For ships under construction, the estimates were based in part on data from the Navy on actual costs; for ships yet to be built, they were based on relationships between the cost and weight of past ships. (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, as applied to the first ship of a class (the lead ship), determine the estimated costs for all subsequent ships. Thus, CBO's estimate of the cost of the lead ship in a class drives 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 a notional design, CBO had to make assumptions about the size and capabilities of future ships. All costs of individual ships in this section exclude outfitting and postdelivery costs, which typically add about 3 percent to the cost of a ship.

Aircraft Carriers

The 2013 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 2013–2042 period. Building 1 carrier every five years (referred to as "five-year centers") would enable the Navy to have a force of at least 11 carriers almost continuously through 2042, with two exceptions. One exception would be from 2013 to 2015, when the number of carriers would drop to 10. That temporary decline would occur because the USS *Enterprise* (CVN-65) is scheduled to be retired in early 2013—after 52 years of service—but the next new carrier, the USS *Gerald R. Ford* (CVN-78), would not be commissioned until late 2015. Any delays in building the new CVN-78 class would extend the period during which the Navy had only 10 carriers. The other exception would be from 2040 to 2042 and beyond; because carriers would be built every five years and serve for 50 years, the Navy's carrier force would fall to 10 in the long run.

The Navy's projected cost of the lead ship of the CVN-78 class grew by 18 percent between the President's budget requests for 2008 and 2013. The Navy's budget now projects the lead ship's cost to be $13.1 billion (about what CBO estimated in its analysis of the Navy's 2011 plan), but further increases are likely. According to information provided by the Navy, in fiscal year 2014 the service will request an extra $497 million ($564 million in 2014 dollars) to cover additional cost growth and additional tooling and vendor services. Including that money in the Navy's estimate boosts the expected cost of the lead ship to $13.6 billion. (That amount does not include $4.7 billion in research and development costs that apply to the entire class.)

To estimate the cost of the lead ship of the CVN-78 class, CBO used the actual costs of the previous carrier—the CVN-77—and then adjusted them for higher costs for 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). CBO estimates that completing the lead CVN-78 will cost $14.2 billion. Subsequent ships of that class will not require as much funding for one-time items, although they will incur the higher costs for government-furnished equipment. Altogether, CBO estimates the average cost of the 6 carriers in the 2013 plan at $13.0 billion, compared with the Navy's estimate of $10.9 billion (see Table 3).

The final cost of the CVN-78 could be even higher than CBO's estimate, for several reasons. First, many lead ships built in the past 20 years have experienced cost growth of more than 30 percent. CBO's estimate for the lead ship already falls within the range of cost growth in lead ships, but construction is only about 40 percent complete. Historically, more cost growth has occurred in the latter stages of ship construction, when systems are being installed and integrated. Second, with the increase in the Navy's estimate, the Navy, in a written response to CBO and the Congressional Research Service, stated that the service has budgeted the CVN-78 to a "greater than 50th" percentile of possible cost outcomes. Because the Navy has not reported a precise probability, the service's view of the probability that the final cost will exceed its estimate is unclear. Third, a number of critical technologies that are supposed to be incorporated into the ship, such as a new electromagnetic catapult system for launching aircraft, remain under development and will require integration as the ship nears the final stages of construction. Difficulties in completing that integration could arise and increase costs, and those increases would also probably affect the costs for subsequent ships of the class. However, the Navy and the shipbuilder recognize those issues and are actively managing the CVN-78 program to reduce costs and prevent further growth. If they succeed, then the cost of the lead ship could be less than CBO's estimate.

Submarines

Under the 2013 shipbuilding plan, submarines would overtake surface combatants as the largest source of demand for shipbuilding funds over the next 20 years (see Table 4 on page 18). The Navy currently operates 14 Ohio class ballistic missile submarines (SSBNs), 4 Ohio class guided missile submarines (SSGNs) modified from the SSBN version, and 53 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 2025; and 13 submarines based on a redesign and improvement of the Virginia class, with production of the new version to start in 2033. The Navy does not plan to replace its 4 SSGNs when they are retired in the mid- to late 2020s.

SSBN(X) Future Fleet Ballistic Missile Submarines. SSBNs carry Trident ballistic missiles and are the sea-based leg of the U.S. 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 slated to replace the Ohio class—are among the most significant uncertainties in the Navy's and CBO's analyses of future shipbuilding. Under the 2013 plan, the first SSBN(X) would be purchased in 2021, compared with 2019 under the 2012 plan (although advance procurement money 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 2 on page 7).

The recent cost history of the program illustrates the uncertainty. The Navy's 2007 and 2008 shipbuilding plans included an assumption that the first SSBN(X) would cost $4.8 billion (in 2012 dollars) and that

Table 3.

Comparison of the Navy's and CBO's Estimates for the Construction of Major New Ships Under the Navy's 2013 Plan

(Billions of 2012 dollars)

	Number of Ships Purchased Under the 2013 Plan	Total Costs per Class Over the 2013–2042 Period		Average Costs per Ship Over the 2013–2042 Period		Memorandum: Average Costs per Ship Under the 2012 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	62 [a]	78 [a]	10.9 [a]	13.0 [a]	10.7	12.8
SSBN(X) Ballistic Missile Submarines (Replacements for Ohio class)	12	78 [b]	90	6.5 [b]	7.5	6.5	7.4
Virginia Class Attack Submarines	33	88	89	2.7	2.7	2.6	2.6
Improved Virginia Class Attack Submarines (Replacements for Virginia class)	13	38	42	2.9	3.2	3.1	3.1
DDG-51 Arleigh Burke Class Destroyers							
Flight IIA	6	10	10	1.6	1.7	1.5	1.8
Flight III	33	71	81	2.2	2.4	2.4	2.2
DDG(X) Destroyers (Replacements for Arleigh Burke class)	31	69	101	2.2	3.3	2.2	3.7
Littoral Combat Ships	43	19	22	0.4 [c]	0.5	0.5	0.5
LCS(X)s (Replacements for littoral combat ships)	27	11	15	0.4 [c]	0.6	0.5	0.6
LSD(X) Amphibious Dock Landing Ships	10	13	17	1.3	1.7	1.3	1.7
LHA-6 Amphibious Assault Ships	6	22	27	3.6	4.3	3.6	4.2
T-AO(X) Oiler	17	9	9	0.5	0.5	0.5	0.7

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

a. In CBO's and the Navy's estimates for aircraft carriers, total costs per class include remaining funds for the CVN-78 and advance procurement funding for the carrier the Navy plans to buy in 2043. CBO's and the Navy's estimates of the average cost per ship exclude that funding but include advance procurement funding for the CVN-79 that was appropriated before 2013.

b. The Navy's estimates for the SSBN(X) reflect the service's official cost estimates for the program, as provided by the SSBN(X) program office.

c. The Navy's estimate for the littoral combat ships (LCSs) is $440 million per ship, and its estimate for the LCS(X)—the replacement ship—is $400 million. Those costs exclude the cost of LCS mission packages, which CBO also excluded from its estimates.

subsequent ships in the class would cost $3.6 billion apiece. The 2012 plan, in contrast, estimated the costs of the SSBN(X) class at an average of $6.5 billion, which was down from an estimated $7.7 billion apiece under the 2011 plan.[12] That cost history highlights the uncertainty that remains in determining how much a future class of SSBNs will cost. Those figures also highlight the great expense of replacing current ballistic missile submarines and the effect that doing so could have on other shipbuilding programs or on programs other than shipbuilding.

Between the 2011 plan and the 2012 plan, the Navy redefined its SSBN(X) design, a primary goal being to

12. 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.

Table 4.

Total Shipbuilding Costs, by Major Category, 1983 to 2042

	Historical				CBO's Estimates Under the Navy's 2013 Plan			
	1983–1992	1993–2002	2003–2012	1983–2012	2013–2022	2023–2032	2033–2042	2013–2042
	Average Annual Costs (Billions of 2012 dollars)							
New-Ship Construction								
Aircraft carriers	2.7	1.5	1.8	2.0	2.3	2.6	2.9	2.6
Submarines	7.5	1.9	3.5	4.3	7.0	8.5	6.3	7.3
Surface combatants	7.6	4.7	3.8	5.4	6.0	7.3	9.7	7.7
Amphibious ships	1.6	1.2	2.0	1.6	1.1	2.0	1.9	1.6
Logistics and support ships	1.8	0.4	0.8	1.0	0.5	1.4	0.4	0.8
Subtotal	21.3	9.7	11.9	14.3	16.8	22.0	21.2	20.0
Carrier and Submarine Refuelings[a]	0.3	0.7	1.1	0.7	1.3	1.1	0.8	1.1
Other Items	1.3	1.2	0.6	1.0	1.0	0.9	0.7	0.9
Total	**22.8**	**11.6**	**13.6**	**16.0**	**19.1**	**24.0**	**22.6**	**21.9**
	Percentage of Average Annual Costs							
New-Ship Construction								
Aircraft carriers	13	15	15	14	12	11	13	12
Submarines	36	19	30	30	36	35	29	33
Surface combatants	36	49	32	38	32	30	43	35
Amphibious ships	8	13	17	11	5	9	9	7
Logistics and support ships	8	4	7	7	3	6	2	4
All Construction	93	84	88	89	88	91	93	91
Carrier and Submarine Refuelings[a]	1	6	8	4	7	5	3	5
Other Items	6	10	4	6	5	4	3	4
All Costs	**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 2013 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.

reduce the cost of the ships. The Navy's cost estimate in the 2011 plan was based on a submarine similar in size to the Ohio class and on the cost to build Ohio class submarines under the current conditions of the shipbuilding industry (such as the number of shipbuilders and vendors and the amount of other business in the shipyards) and using today's technology. The Navy states that it was able to reduce the estimated cost of the SSBN(X) to the current level by making the following changes:

- Using a less expensive, 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;
- Reducing the capability of the torpedo room and various sensor arrays and reducing the size of the sail mast; and
- Increasing the use of components from the Virginia class attack submarines.[13]

The Navy currently estimates the cost of the lead SSBN(X) at $11.7 billion. The average cost of follow-on ships is $6.0 billion, and the Navy has stated an objective of reducing that cost to $5.0 billion.[14] All told, the Navy estimates that building 12 of the submarines will cost $78 billion, or an average of $6.5 billion each.

In comparison, CBO estimates that the lead SSBN(X) will cost $13.3 billion on the basis of its scheduled purchase in 2021. Estimating the cost of the first submarine of a class is particularly difficult because it is not clear how much the Navy will need to spend on nonrecurring engineering and detail design. The Navy spent about $2 billion on those items for the lead Virginia class attack submarine. The historical track 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. In addition, CBO assumed that the cost of nonrecurring items is proportional to the weight of submarines. Therefore, CBO estimated that nonrecurring items would cost about $5 billion for the lead SSBN(X), which will be approximately the size of an Ohio class submarine and thus about 2½ times the size of a Virginia class submarine. The Navy's estimate for the lead SSBN(X) reflects the fact that the service estimates that nonrecurring costs will be $4.5 billion.

Overall, 12 SSBN(X)s would cost a total of about $90 billion in CBO's estimation, or an average of $7.5 billion each. That average includes the $13.3 billion estimated cost of the lead ship and a $7.0 billion average estimated cost for the 2nd through 12th ships. Research and development would cost an additional $10 billion to $15 billion, for a total program cost of $100 billion to $110 billion. (Note that CBO's estimate under the 2012 plan was an average of $7.4 billion per submarine; the estimate for the 2013 plan is higher primarily because the purchases occur two years later than under the 2012 plan, thus incurring two additional years of cost growth.)

Attack Submarines. Under the 2013 plan, the Navy would buy 33 Virginia class attack submarines at a rate of 2 per year on average from 2013 through 2025, with the exceptions of 2014 and 2024, when the Navy would buy 1 per year, and 2020 and 2022, when the Navy would buy 3 per year. Starting in 2026, the Navy would buy attack submarines at a rate of 1 per year, switching to the improved Virginia class in 2033. Beginning in 2038, the service would buy those submarines at a rate of 1 or 2 per year through 2042. With such a procurement schedule, the attack submarine force would remain at or above the Navy's goal of approximately 48 through 2021 but would then fall to between 43 and 47 submarines between 2022 and 2034 (see Figure 3 on page 8).

Senior Navy leaders have stated—and the 2013 plan assumes—that Virginia class SSNs would have to cost $2.6 billion or less for the Navy to be able to afford 2 per year.[15] The President's 2013 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 2013 and 2033 would be about $88 billion—slightly less than 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 original Virginia class, which itself regularly receives technological upgrades to its systems and capabilities. Similarly, CBO assumed that the replacement for the Virginia class would incorporate some significant technological improvements that would, in essence, define the improved Virginia as a new class but would not constitute an entirely new design. On the basis of that assumption, CBO estimated

13. 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, June 3, 2010); 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).

14. Briefing by the Navy to the staff of the House Committee on Armed Services, CBO, and the Congressional Research Service, February 28, 2011.

15. Specifically, the Navy has said that to purchase 2 Virginia class submarines a year, their cost would have to decline to $2.0 billion each in 2005 dollars, which is equivalent to $2.6 billion in 2012 dollars.

that the average cost of the improved Virginia class would be $3.2 billion, compared with the Navy's estimate of $2.9 billion. The gap between CBO's and the Navy's estimates stems from two factors. First, the Navy reduced the estimated cost of its improved Virginia class submarine from the 2012 plan, despite delaying the start of the class by eight years and changing from 2011 dollars to 2012 dollars, but did not explain why the estimate was lower. Second, CBO's estimate incorporates the difference between inflation experienced by the naval shipbuilding industry and that occurring in the overall economy. All of the improved Virginia class submarines are now being purchased in the final decade of the 30-year plan, the period during which the long-term cumulative effect of that cost growth is most pronounced.

Although the Navy's plan does not include submarines to replace the SSGNs when they retire in the 2020s, the service is considering an option to 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 increase 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 the additional payload modules would provide a "near equivalent" to the strike capability of the existing force of 4 SSGNs. The President's 2013 budget would spend $800 million between 2013 and 2017 for research and development of the payload module and for modifying the design of the Virginia class. If the Navy decided to include the payload module in future submarine purchases (those beyond 2017), those modified boats would require greater funding than what the Navy or CBO estimates for the 2013 plan.

Large Surface Combatants

The Navy is buying the same types of destroyers as in its 2012 plan but will buy 18 more of them. The service is proceeding with its plans to restart production of DDG-51 Flight IIA destroyers, with the first ship funded in the 2010 budget, 2 more in 2011, 1 in 2012, and 6 more planned for 2013 to 2016. Beginning with 1 of 2 ships ordered in 2016 and then continuing through 2030, new DDG-51s would have an upgraded design, a configuration known as Flight III. By far the most significant change the Navy made in its 2013 shipbuilding plan from the previous year was to propose to buy 50 percent more DDG-51s, increasing its purchases from 22 Flight IIIs under the 2012 plan to 33 under the 2013 plan. In 2031, the Navy would start buying 31 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 new goal for about 90 large surface combatants through 2029, although the force would fall below that goal between 2030 and 2038 (see Figure 3 on page 8).

In addition to the ship purchases, a critical element of the Navy's plan to achieve its projected inventory levels is the assumption that all DDG-51 Flight IIA and subsequent destroyers would serve in the fleet for 40 years. The class was originally designed to serve for 30 years, but the Navy has subsequently increased the planned service life—first to 35 years and then, for Flight IIA ships and beyond, to 40 years in the 2009 shipbuilding plan. Historically, 12 of the last 13 classes of destroyers and cruisers were 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 25 years of service or less (the only exception was the CGN-9 *Long Beach*, a class of one). The Navy retired those ships 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 not cost-effective.[16] If the DDG-51 class met the same fate, the shortfall in meeting the Navy's inventory goal for destroyers and cruisers would grow substantially (see Figure 7, which illustrates the effect on the force level for large surface combatants if the service life of those ships is only 35 or 30 years and the Navy does not increase the number of such ships it plans to purchase).

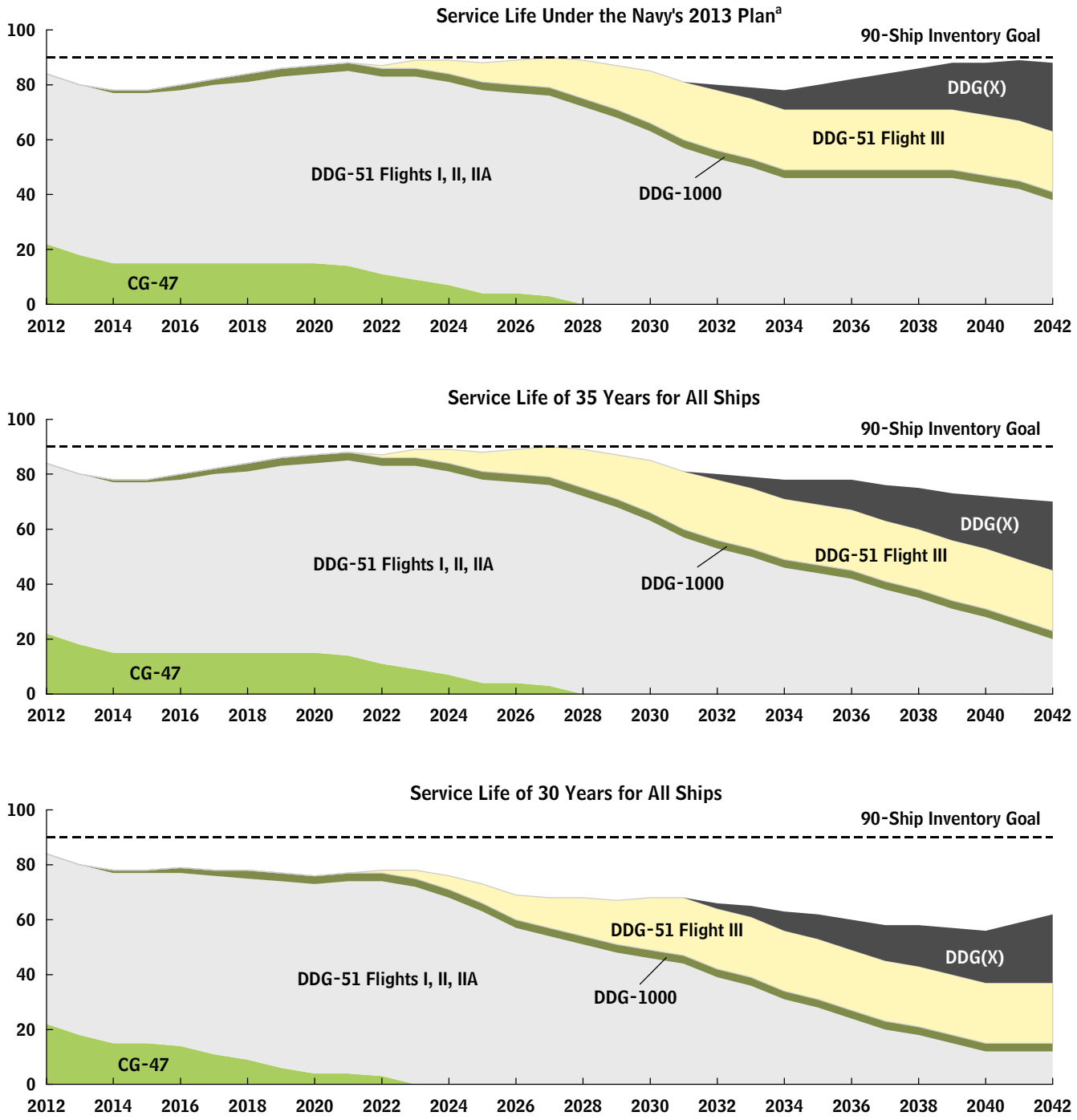
DDG-51 Flight IIAs. The Navy's existing DDG-51 destroyers were built in three primary configurations. The first 28 ships, designated Flight I or II, did not include a hangar for embarking helicopters (which play important roles in countering enemy submarines, mines, and attacks by small boats). The next 34 ships were designated Flight IIA, which included a hangar and were thus able to carry two helicopters or several ship-launched

16. 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).

Figure 7.

Inventory of Large Surface Combatants Under Various Scenarios for Service Life

(Number)



Source: Congressional Budget Office.

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

a. The Navy's 2013 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.

unmanned aerial vehicles.[17] Under the Navy's 2013 plan, 6 new DDG-51s purchased through 2016 (in addition to 4 purchased between 2010 and 2012) would use the Flight IIA configuration but would also incorporate the latest ballistic missile defense capabilities.[18] Those ships would have an average cost of $1.7 billion, in CBO's estimation—about $100 million more than the Navy's per-ship estimate. CBO's higher figure stems partly from the expectation that restarting a production line that last received an order in 2005 will cost more than the Navy anticipates.

DDG-51 Flight IIIs. The Navy's strategy to meet combatant commanders' demand for the increased ballistic missile defense capabilities beyond what 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. 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 would require increasing the amount of power and cooling available on a Flight III ship in order to operate the radar effectively.[19] With those changes and associated increases in the ship's displacement, a DDG-51 Flight III would cost $700 million, or about 40 percent, more than a new Flight IIA, by CBO's estimate.[20] Thus, CBO estimates, the average cost per ship would be $2.4 billion. Overall, the Navy plans to buy 33 DDG-51 Flight III ships between 2016 and 2030.

CBO's estimate of the cost of each of those ships is about $200 million more than it was last year. Most of the increase stemmed from updated information on the cost of incorporating the AMDR into the Flight IIA configuration. At the same time, the Navy decreased its estimate for the average price of a DDG-51 Flight III from $2.4 billion in the 2012 plan to $2.2 billion in the 2013 plan, primarily by incorporating the use of multiyear procurement authority in its estimates, as it did for all destroyers bought between 1998 and 2005.[21] Considerable uncertainty remains in the DDG-51 Flight III program, however. Costs could be substantially higher or lower than CBO's estimate, depending on how well the restart of the DDG-51 program goes and on the eventual cost and complexity of the AMDR and associated changes in the ship's design.

DDG(X) Future Guided Missile Destroyers. Like the Navy's 2012 shipbuilding plan, the current plan includes a future class of destroyers intended to eventually replace the DDG-51 Flight I and II ships when they retire in the late 2020s and 2030s.[22] The 2013 plan designates those ships as the DDG-51 Flight IV, consistent with the 2012 plan. [The 2011 plan used a more generic DDG(X) designation.] For this discussion, CBO uses the DDG(X) designation because the agency considers it unrealistic

17. 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,* 18th ed. (Naval Institute Press, 2005), pp. 147–152.

18. 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, June 12, 2012).

19. See Ronald O'Rourke, *Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress,* CRS Report for Congress RL33745 (Congressional Research Service, June 23, 2012), and *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress,* CRS Report for Congress RL32109 (Congressional Research Service, June 12, 2012).

20. 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 much more extensive changes than the transition from the Flight I/II to Flight IIA ships.

21. Multiyear procurement authority, which the Congress must authorize, reduces costs by allowing bulk purchases of many materials for a group of ships that are to be acquired over a specified number of years, rather than individual purchases of those materials each time a ship is authorized. In addition, multiyear procurement provides a predictable and stable body of work for the shipyards, which reduces administrative costs and provides incentives to improve efficiency in ship construction. All of those factors, which are known to the shipyard and to the Navy, allow the service to negotiate better prices for ships that are covered by multiyear procurement. For more information, see Ronald O'Rourke and Moshe Schwartz, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*, CRS Report for Congress R41909 (Congressional Research Service, June 13, 2012).

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

that the Navy would or could use the DDG-51 design for the next-generation destroyer.

Under the current plan, production of the DDG(X) would start in 2031, 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 design of the DDG-51 class but incorporate technological improvements appropriate for the late 2020s and early 2030s. According to the Navy, it would buy 31 DDG(X)s at an average cost of $2.2 billion, the same price as the DDG-51 Flight III. It is not clear why the Navy thinks the prices of those two ships would be the same if the DDG(X) represents an improvement over the Flight III. Technological upgrades would probably make the DDG(X) at least somewhat more expensive, not unlike the premium the Navy expects to pay for the DDG-51 Flight III compared with the cost of the Flight IIA. But in assuming that the underlying price of the two types of destroyers would be the same, the Navy is allowing for essentially no cost-increasing improvements in the DDG(X)'s capabilities compared with those of the preceding DDG-51 Flight III class.

CBO, in contrast, assumed that the DDG(X) would have a largely new design and would be about 10 percent bigger than the DDG-51 Flight III. By 2031, 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 that originated in the late 1970s and early 1980s will prove robust enough to accommodate changes designed 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. As an example, the Navy has limited ability to improve the "stealthiness" of the DDG-51 class if it does not redesign the hull—and if it does, it will, in effect, have designed an entirely new ship. Under those assumptions, CBO projects the average cost of the DDG(X) at $3.3 billion, compared with its estimate of $3.7 billion under the 2012 plan. The lower CBO estimate is the result of increased production rates for the DDG(X), which lower overhead costs, and greater learning, which reduces the overall average cost. CBO's estimate of $3.3 billion is about 50 percent greater than the Navy's current estimate of $2.2 billion. Over the 2013–2042 period, CBO estimates, the Navy would have to spend $101 billion—$32 billion more than the Navy's estimate of $69 billion.

Littoral Combat Ships

In the 2013 plan, the Navy envisions building a force of 55 littoral combat ships (LCSs) between 2005 and 2026. Because those ships are assumed to have a service life of 25 years, the Navy would need to begin procuring their replacements in 2030. To achieve that goal, the Navy would purchase 43 LCSs through 2029 and 27 next-generation ships, called LCS(X)s, beginning in 2030.

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 built to be able to switch mission packages, depending on the ship's intended mission at a given time. 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 55-ship program.[23]

The Navy wants the LCS to be a relatively affordable ship (compared with other surface combatants) that will be fairly easy to design and build. However, the program has experienced significant cost growth since its inception. Originally, each sea frame was expected to cost $290 million, on average, in 2012 dollars (or $220 million in 2005 dollars). So far, 2 LCSs have been built, by different contractors using different designs, and 2 more are nearly finished. The LCS-1, based on a semiplaning steel monohull, cost $594 million to build (not including $40 million invested by the contractor); the LCS-2, based on an all-aluminum trimaran (basically, a three-hulled ship), cost $652 million. Including outfitting and post-delivery costs and some nonrecurring costs to complete the designs (which normally are not considered part of a ship's construction cost), the price tags of those ships rise to about $770 million and $800 million, respectively.

In 2009, when the Navy was authorized to buy two more LCSs, it ordered one of each design. After that, however, it revamped its acquisition strategy in an attempt to counter the cost growth and turmoil in the LCS program.

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

Earlier, the Navy had planned to continue building both designs and have the two contractors compete to see which one would produce the larger number of ships. In the summer and fall of 2009, the Navy changed course and decided it would instead select one design for the 15 LCSs it expected to order between 2010 and 2014. The contractor whose design was chosen would build 10 ships—2 per year—between 2010 and 2014, and in 2012 the Navy would hold another competition for 5 more ships of the same design to bring a second shipyard into the construction process. The Navy hoped that strategy would lead to a competitive environment for LCS purchases in 2015 and beyond, thus lowering costs. In the Navy's view, the result was so successful—the bids from each contractor were so low—that the service asked for and received authorization from the Congress in December 2010 to accept both bids, purchasing 20 ships (10 from each builder) between 2010 and 2015, subject to annual appropriations by the Congress.[24] Each shipyard will build 2 ships with funds appropriated in 2010 and 2011, and then 2 ships per year from 2012 to 2015 if further funds are appropriated.[25] Thus, by 2015, the Navy will have purchased 12 ships of each LCS design, for a total of 24.

The Navy has not determined its acquisition strategy for the remainder of the 55-ship program, although the 2013 plan states that the Navy will keep both designs in production through 2026, when the program ends. Nevertheless, the Navy could change that plan once it has more experience with the two designs. It could select one design for the remainder of the program, or it could hold another competition that included both designs. The Navy plans to see how well the existing shipyards perform in executing their contracts before it decides how to acquire the rest of the ships.

In the five-year 2013 Future Years Defense Program, the Navy estimated the average cost of the LCS at about $440 million per ship, including the 4 ships (2 per year) bought in 2016 and 2017, after the end of the 10-ship contract. The current figure is well below the Congressionally mandated cost cap for the LCS program ($500 million per ship, adjusted for inflation).[26] According to the Navy, the new, lower prices reflect the benefits of the competition the Navy held for the program last year. The Navy assumed that ships purchased after 2017 would continue to cost about $440 million.

The key to the future of LCS prices will be how well each shipbuilder can execute its 10-ship contract. If the shipyards are able to build the ships without major delays or cost overruns, then the Navy could obtain future prices that are similar (adjusted for inflation) to the ones it received under the recent competition. If one or both shipyards find it difficult to build LCSs for the prices to which they agreed under the 10-ship contracts, then the prices for ships purchased after 2015 could be higher. More generally, the Navy faces a difficult trade-off in managing its future acquisitions of LCSs. Selecting a single design and one shipyard to build to that design would economize on overhead costs, but in so doing the Navy would sacrifice the competitive pressure that could help hold down costs for future ship purchases. Conversely, continuing to purchase two types of LCSs might maintain some competitive pressure but at the expense of a lower production rate and thus higher average overhead costs in the two shipyards.[27]

CBO adjusted its estimate for 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 does not expect that the Navy will get the same 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 43 LCSs in the plan at about $500 million.

24. 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).

25. For more detail on the LCS program, see Ronald O'Rourke, *Navy Littoral Combat Ship (LCS) Program: Background, Issues, and Options for Congress,* CRS Report for Congress RL33741 (Congressional Research Service, June 13, 2012).

26. The National Defense Authorization Act for Fiscal Year 2010 (P.L. 111-84), which set the LCS cost cap to begin in 2011, 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.

27. The Navy's budget estimates assume that the 2 ships purchased in 2017 will be cheaper on average than the 4 ships purchased in 2015. If the Navy maintained two shipbuilders for the LCS program, greater overhead costs from reducing the purchases from each shipbuilder would almost certainly increase the cost of the ships purchased in 2017.

The 2013 shipbuilding plan shows a faster procurement rate for LCSs than under the previous plan. Under the 2012 plan, the Navy would have purchased up to 4 LCSs a year between 2013 and 2015, 3 per year thereafter, and then 1 or 2 per year starting in 2020. Under the 2013 plan, the Navy would purchase only 2 LCSs in both 2016 and 2017 but would then complete the remainder of the program at a rate of 3 ships per year. As a result, the service would achieve a force of 55 LCSs in 2029 rather than in 2035, as under the 2012 plan.

The Navy would also buy 27 next-generation littoral combat ships—called LCS(X)s—beginning in 2030. The Navy's cost estimate for the LCS(X) under the 2013 plan is $400 million, or $40 million less than the average cost of the original LCS and about $100 million per ship lower than under the 2012 plan. In contrast, CBO estimates the average cost of the LCS(X) at about $600 million per ship, consistent with its estimate under the 2012 plan.

Amphibious Warfare Ships

In the text of the 2011 shipbuilding plan (updated with the 2012 tables), the Navy implied that its new goal for its amphibious force would be 33 ships, up from 31 previously.[28] In the 2013 plan, the Navy reduced that goal to approximately 32 amphibious ships. The proposed force would consist of 11 LHA or LHD amphibious assault ships, 11 LPD amphibious transport docks, and 10 LSD dock landing ships. In pursuit of that force, the 2013 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.[29] The plan envisions buying 10 LSD(X) dock landing ships (1 every other year between 2018 and 2028 and then 1 per year until 2032) to replace existing dock landing ships in the LSD-41 and LSD-49 classes. The 2013 plan would also start replacing the LPD-17 class with a new class, 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 approximately 32 ships starting in 2018 and for the reminder of the 30-year plan (see Figure 3 on page 8). One way in which the Navy achieves that force level is by assuming that the existing class of LHD-1 amphibious assault ships would serve between 43 and 45 years, a marked increase over the assumption in the 2012 plan of a 40-year service life.

The Navy's cost estimates for amphibious warfare ships have not changed significantly since the 2012 plan. In the 2013 plan, the Navy assumes that the LSD(X)s 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 for the LSD(X) at $1.3 billion per ship. CBO puts the figure at $1.7 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.

28. Specifically, the report says that 33 is the minimum number of amphibious warfare ships needed to "support a forcible entry operation conducted by the assault echelon of 2.0 Marine Expeditionary Brigades." See Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011* (February 2010), p. 15.

29. 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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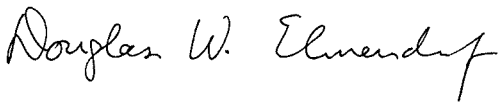
About This Document

This Congressional Budget Office report 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 under the general supervision of David E. Mosher and Matthew Goldberg. Raymond Hall of CBO's Budget Analysis Division produced the cost estimates under the general supervision of Sarah Jennings. Melissa Merrell and Michael Bennett of CBO provided helpful comments on the report, as did Ronald O'Rourke of the Congressional Research Service. (The assistance of an external reviewer implies no responsibility for the final product, which rests solely with CBO.)

Sherry Snyder edited the report, and Jeanine Rees and Maureen Costantino prepared the report for publication. An electronic version is available on CBO's Web site (www.cbo.gov).



Douglas W. Elmendorf
Director

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