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An Analysis of the Navy's Fiscal Year 2012 Shipbuilding Plan

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An Analysis of the Navy's Fiscal Year 2012 Shipbuilding Plan

June 2011

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Notes

Unless otherwise indicated, all dollar amounts in this study reflect budget authority in 2011 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.

The cover shows the following U.S. Navy ships (clockwise from upper right): the Ohio class ballistic missile submarine USS *Alabama* (SSBN-731), photo by Ray Narimatsu; the Nimitz class aircraft carrier USS *Carl Vinson* (CVN-70), photo by Mass Communication Specialist Seaman Nicolas C. Lopez; the San Antonio class amphibious transport dock ship USS *New Orleans* (LPD-18), photo by Chief Mass Communication Specialist Joe Kane; and the Arleigh Burke class guided-missile destroyer USS *Decatur* (DDG-73), photo by Mass Communication Specialist First Class Jennifer A. Villalovos.

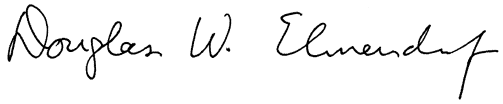
Preface

Since 2006, the Congressional Budget Office (CBO) has performed an independent analysis of the Navy's latest shipbuilding plan at the request of the Subcommittee on Seapower and Expeditionary Forces of the House Armed Services Committee. This CBO study, the latest in that series, summarizes the ship inventory goals and purchases described in the Navy's 2012 plan and assesses their implications for the Navy's funding needs and ship inventories through 2041.

The Navy currently envisions buying a total of 275 ships during the next 30 years at an average annual cost of nearly $16 billion (in 2011 dollars) for new construction alone or a little more than $17 billion for total shipbuilding, which includes new construction, refueling of nuclear-powered aircraft carriers, and other costs related to shipbuilding. By comparison, CBO estimates that the cost of the Navy's plan will average $18 billion per year for new construction or $20 billion per year for total shipbuilding. In keeping with CBO's mandate to provide objective, impartial analysis, this study makes no recommendations.

Eric J. Labs of CBO's National Security Division prepared the study under the general supervision of David Mosher. Raymond Hall of CBO's Budget Analysis Division produced the cost estimates under the general supervision of Sarah Jennings. Bernard Kempinski provided helpful comments on the report, as did Ronald O'Rourke of the Congressional Research Service. (The assistance of external reviewers implies no responsibility for the final product, which rests solely with CBO.)

John Skeen and Kate Kelly edited the document, and Loretta Lettner proofread it. Jeanine Rees prepared the study for publication, and Maureen Costantino designed the cover. Monte Ruffin printed the initial copies, and Linda Schimmel coordinated the print distribution. This publication is available on CBO's Web site (www.cbo.gov).



Douglas W. Elmendorf
Director

June 2011

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Summary

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.[1] 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 submits the Quadrennial Defense Review. Instead, the report accompanying the legislation required the Navy to submit a 10-year shipbuilding plan if requested by the appropriate oversight committees.

Consequently, for fiscal year 2012, the Navy's intentions for shipbuilding came out in stages, in documents that can be combined with one another and with the plan of the previous year to yield a new 30-year plan comparable to previous ones. In late February, the Navy provided briefing slides highlighting the major changes the service had made in the schedule for constructing new ships and retiring older ones during the next 10 years, as well as providing some information about the expected cost of the shipbuilding called for in the new schedule. In late May, at the request of the House Armed Services Committee, the Navy provided tables showing a 30-year schedule that made a number of adjustments to the schedule released one year earlier. CBO viewed those briefing slides and tables as reflecting a 2012 shipbuilding plan that represents a modification to the previous year's plan.

Although the total costs of carrying out the Navy's 2012 plan would be less than those for the 2011 plan, they would still be much higher than the funding levels that the Navy has received in recent years. Specifically:

- The Navy's documents constituting its 2012 shipbuilding plan imply 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 328—up from 322 or 323 under the 2011 plan (that plan was unclear as to whether the inventory goal for carriers was 10 or 11) and 313 in the Navy's three previous long-term plans, which were based on its 2005 assessment of the desired force structure.[2] The battle force fleet currently numbers 286 ships. (Summary Box 1 on page x describes the major ships in the Navy's fleet.)

- Under the 2012 plan, the Navy would buy a total of 275 ships over the 2012–2041 period: 205 combat ships and 70 logistics and support ships, including 5 for the Army (see Summary Table 1). Given the rate at which the Navy plans to retire ships from the fleet, that construction plan is insufficient to achieve a 328-ship fleet.

- In comparison, in the 2011 shipbuilding plan, the Navy envisioned buying 198 combat ships and 78 logistics and support ships between 2011 and 2040, for a total of 276. That plan was insufficient to achieve a fleet of 322 or 323 ships.

- The Navy estimates that buying the new ships in the 2012 plan will cost an average of about $15.5 billion per year, or a total of $465 billion over 30 years (about 6 percent less than its estimate for the 2011 plan). Those figures are solely for the construction of new ships, the only type of costs reported in the Navy's 30-year shipbuilding plans. However, other activities

1. The 2011 shipbuilding plan is Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011* (February 2010), www.militarytimes.com/static/projects/pages/2011shipbuilding.pdf.

2. If 5 joint high-speed vessels intended to be purchased by the Army but operated by the Navy and included in the Navy's reported inventory of battle force ships are not counted as part of the Navy's inventory objective, then the goal would be 323 ships.

Summary Table 1.

Comparison of the Navy's Long-Term Shipbuilding Plans for Fiscal Years 2011 and 2012

	2011 Plan (2011–2040)	2012 Plan (2012–2041)
	Number of Ships Purchased Over 30 Years	
Aircraft Carriers	6	6
Ballistic Missile Submarines	12	12
Attack Submarines	44	44
Large Surface Combatants	50	52
Littoral Combat Ships	66	71 [a]
Amphibious Warfare Ships	20	20
Combat Logistics Force and Support Ships	78	65
Total Navy Ships	**276**	**270**
Army Support Ships[b]	**n.a.**	**5**
Total Ships	**276**	**275**
	Costs (Billions of 2011 dollars)	
Total Cost of New-Ship Construction over 30 Years[c]		
Navy's estimate	490	465 [d]
CBO's estimate	585	539
Average Annual Cost of New-Ship Construction		
Navy's estimate	16.3	15.5 [d]
CBO's estimate	19.5	18.0
Average Price per Navy Ship		
Navy's estimate	1.8	1.7 [d]
CBO's estimate	2.1	2.0

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

Note: n.a. = not applicable.

a. The Navy plans to have 55 littoral combat ships in service after 2035. However, because those ships are expected to be in service for 25 years each, the Navy will begin buying replacements in 2032.

b. Army support ships are joint high-speed vessels—small fast ferries for transporting small numbers of personnel or equipment within a theater of operations. The Navy will acquire and operate the ships, but the Army will pay for them. 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. Including their costs would add about $900 million to the Navy's and CBO's total.

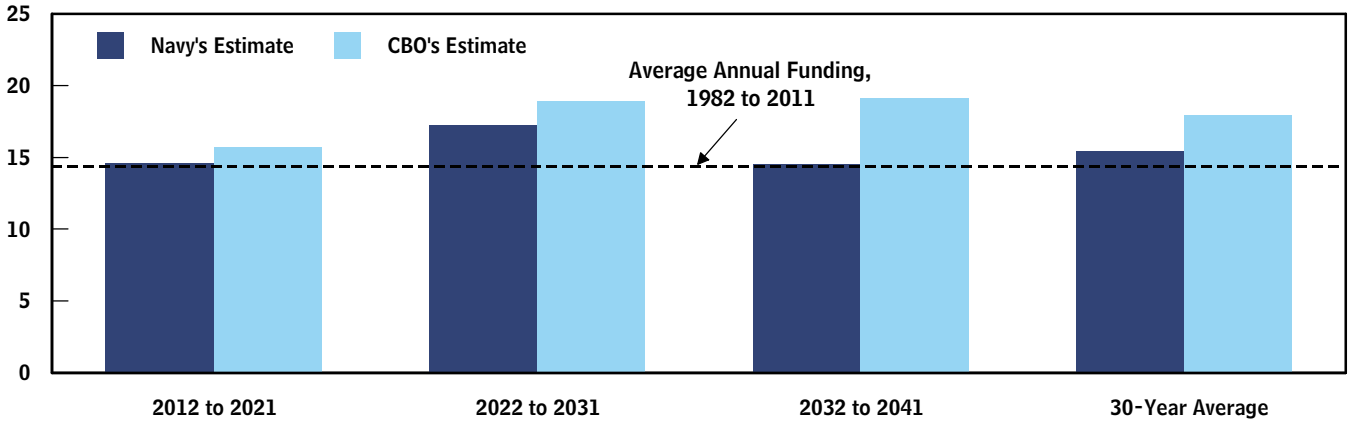
c. The costs to construct new ships exclude the costs of refueling existing nuclear-powered aircraft carriers as well as outfitting and postdelivery costs (which cover various activities and small items, such as tools and equipment, that a ship needs to operate but that are not necessarily provided by the shipyard when the ship is built).

d. CBO adjusted the Navy's estimate to reflect the service's official cost estimate for the SSBN(X) ballistic missile submarine.

Summary Figure 1.

Average Annual Costs of New-Ship Construction Under the Navy's 2012 Plan

(Billions of 2011 dollars)



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

Note: The costs to construct new ships exclude the costs of refueling existing nuclear-powered aircraft carriers as well as outfitting and postdelivery costs (which cover various activities and small items, such as tools and equipment, that a ship needs to operate but that are not necessarily provided by the shipyard when the ship is built).

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 nearly $2 billion to the Navy's average annual shipbuilding costs under the 2012 plan, which would bring the total to $17.3 billion per year on average.

- Using its own models and assumptions, CBO estimates that the cost for new-ship construction under the 2012 plan will average about $18.0 billion per year, or a total of $539 billion through 2041.[3] Including the expense of refueling aircraft carriers as well as outfitting new ships raises that average to about $19.8 billion per year, CBO estimates. Those figures are about 8 percent lower than CBO's estimates of the Navy's 2011 plan.

- CBO's estimate of the costs for new-ship construction in the 2012 shipbuilding plan is about 16 percent higher than the Navy's estimate overall. That figure masks considerable variation over time, however: CBO's estimates are 7 percent higher than the Navy's for the first 10 years of the plan, 10 percent higher for the following decade, and 31 percent higher for the final 10 years of the plan (see Summary Figure 1). Those differences result partly from different estimating methods and different assumptions about the designs and capabilities of future ships. The differences also arise partly because 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.

- If the Navy receives the same amount of funding for ship construction in the next 30 years as it has over the past three decades, it will not be able to afford all of the purchases in the 2012 plan.[4] CBO's estimate of the full cost of the Navy's 2012 shipbuilding plan is about 27 percent above the average funding of almost $16 billion per year (in 2011 dollars) that the Navy has received over the past three decades.

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, and the fact that costs of labor and materials in the naval shipbuilding industry have generally risen faster than costs in the economy as a whole.

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, House Committee on Armed Services, *The Long-Term Outlook for the U.S. Navy's Fleet* (January 20, 2010).

Summary Box 1.

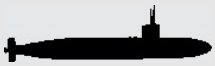
The Roles of Major Types of Ships in the Navy's Fleet

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 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. Different types of surface combatants have displacements ranging from 9,000 to 15,000 tons.

Freedom Class
Littoral Combat Ship

Small surface combatants are frigates and, in the future, 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 participate in patrolling sea lanes, providing an overseas presence, and conducting exercises with allies. These ships range in size from 3,000 to 4,000 tons.

Wasp Class Amphibious
Assault Ship

The Navy's two classes of **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.

Austin Class Amphibious
Transport Dock

The Navy has four other classes of amphibious warfare ships, and such ships 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 **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. These ships can be as small as 2,000 tons for an ocean-going 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.

An Analysis of the Navy's Fiscal Year 2012 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. The report accompanying the legislation required the Navy to submit a 10-year shipbuilding plan if requested by the appropriate oversight committees.

Consequently, for fiscal year 2012, the Navy's intentions for shipbuilding came out in stages, in documents that can be combined with one another and with the plan of the previous year to yield a new 30-year plan comparable to previous ones. In late February, the Navy provided briefing slides highlighting the major changes the service had made in the schedule for constructing new ships and retiring older ones during the next 10 years, as well as providing some information about the expected cost of the shipbuilding called for in the new schedule. In late May, at the request of the House Armed Services Committee, the Navy provided tables showing a 30-year schedule that made a number of adjustments to the schedule released one year earlier. CBO analyzed the 2012 briefing slides and tables as a modification to the Navy's 2011 30-year shipbuilding plan.

The 2011 and 2012 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 the amount of money needed to implement the plans. As it has for each of the Navy's long-term shipbuilding plans in recent years, CBO examined the 2012 plan in detail and produced estimates of 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 2012 Plan

The tables that constitute the 2012 shipbuilding plan hew closely to the information provided in the 2011 30-year shipbuilding report. That document, which the Deputy Secretary of Defense submitted to the Congress on February 1, 2010, described the 313-ship fleet as the "baseline" for the Navy's 2011 goals for ship construction over the next 30 years. However, the report went on to

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 2011 shipbuilding plan is Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011* (February 2010), www.militarytimes.com/static/projects/pages/2011shipbuilding.pdf.

Table 1.

The Navy's Evolving Force-Structure Goals

	Goals for a 313-Ship Fleet in the Navy's 2005 Force-Structure Assessment	Goals Implied in the Navy's 2011 Plan	Goals Implied in the Navy's 2012 Plan
Aircraft Carriers	11	10–11	11
Submarines			
Ballistic missile	14	12	12
Attack	48	48	48
Guided missile	4	0	0
Large Surface Combatants			
Cruisers	19	0	0
Destroyers	69	88 [a]	94
Littoral Combat Ships	55	55	55
Amphibious Warfare Ships	31	33	33
MPF(F) Ships	12	0	0
Combat Logistics Force Ships	30	30	30
Support Ships			
Joint high-speed vessels	3	23	21 [b]
Other[c]	17	23	24
Total	**313**	**322–323** [a]	**328** [b]

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

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

a. The minimum implied goal. If the eventual goal for destroyers was more than 88, the total goal for the fleet could exceed 323 ships.

b. Includes 5 joint high-speed vessels 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 those vessels were excluded from the Navy's force-structure goals, the inventory goal would be 323 ships.

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

describe changes to several categories of ships that would ultimately increase the goal for battle force ships to 322 or 323 ships.[3] The 2012 plan maintains virtually the same set of inventory objectives but makes small changes to the number of large surface combatants (destroyers and cruisers) and to two types of support ships:

- The number of destroyers and cruisers was increased from 88 to 94 (see Table 1).[4]
- The planned fleet of joint high-speed vessels (JHSVs), which are small fast ferries for transporting small numbers of personnel or equipment within a theater of operations, was reduced from 23 to 21 ships.[5]
- The number of T-AGOS ocean surveillance ships was increased from 5 to 6.

In addition, Navy officials have recently stated that the inventory goal for carriers is 11 ships, while the 2011 plan was not clear about whether the goal was 10 or 11 ships. Taken together, those changes effectively produce a fleet objective of 328 ships.

The 2011 shipbuilding report also stated that the Navy plans to conduct a new force-structure analysis to officially determine what its future inventory goal will be; that analysis has not yet been released. (The most recent force-structure analysis was conducted in 2005, and its results led to the 313-ship objective.) This CBO study does not evaluate the force-structure goals identified by the Navy. Rather, it assesses the costs of the Navy's shipbuilding plan, its effects on the force structure, and the extent to which the 2012 plan would satisfy the Navy's objectives for major components of the U.S. fleet.

3. For a detailed discussion of the changes in the Navy's shipbuilding goals from the 313-ship fleet to one of about 322 or 323 ships, see Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2011 Shipbuilding Plan* (May 2010).

4. For official confirmation of the change in the inventory objective for large surface combatants, 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, 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 force of 23 JHSVs was implied by the ship purchases in the 2011 plan, and that number was explicitly mentioned in slides that the Navy used to brief Members of Congress and their staffs, the Congressional Budget Office, and the Congressional Research Service. For the 2012 plan, 16 ships are slated for Navy missions and an additional 5 ships, which will be operated by the Navy, are slated for Army missions but may also be used to fulfill Navy tasks. It is not clear at this time whether the Navy considers its goal for JHSVs to be 16 or 21. For this analysis, CBO assumed the number would be 21 because the Navy counts in its inventory of battle force ships the additional 5 ships purchased by the Army.

Ship Purchases and Inventories Under the 2012 Plan

The Navy intends to buy 10 ships in 2012 (see Figures 1 and 2) and a total of 54 ships between 2012 and 2016 (the period covered by DoD's current Future Years Defense Program, or FYDP).[6] Thereafter, the Navy would buy another 221 vessels through 2041—for a total of 275 ships over 30 years, or an average of 9.2 per year. The pace of shipbuilding would be faster in the near term than later on: The Navy plans to purchase an average of 11 ships annually between 2012 and 2021, with production of littoral combat ships increasing to three or four per year and production of joint high-speed vessels rising to two per year.[7]

If implemented as described above, the 2012 plan would enable the Navy to reach its earlier 313-ship goal by 2019. However, the fleet would remain at or above that number for only nine years. After that, as older ships are retired faster than new ones are brought into service, the fleet would fall to a low of 291 ships in 2033 before increasing to 298 ships by 2041. The current plan would never achieve the implied goal of 328 ships.[8]

Altogether, the Navy would buy almost the same number of ships over 30 years under the 2012 plan as it would have bought under the previous plan.[9] Moreover, the composition of ship purchases—particularly the mix of combat ships and logistics and support vessels—is similar under the 2011 and 2012 plans.

6. The FYDP is a five- or six-year funding plan that DoD updates annually.

7. Littoral combat ships are small surface combatants designed to operate in coastal waters.

8. If the expected service life of ships in the fleet is 35 years, the Navy needs to purchase an average of 9.4 ships per year to maintain a 328-ship fleet. Over the past 19 years, however, the Navy has acquired ships at the rate of 6.5 per year, which would result in a fleet of 228 ships at the end of 35 years.

9. The change in the time frame covered by the two plans—2011 to 2040 versus 2012 to 2041—accounts for a difference of only one ship. The 2011 plan called for buying nine ships in 2011, whereas the 2012 plan includes the purchase of eight ships in 2041. In the Department of Defense Appropriations Act, 2011 (Division A of Public Law 112-10), the Congress deviated from the Navy's plan by moving the purchase of one ship from 2013 to 2011, thereby increasing the total to 10 ships in 2011.

Combat Ships

Under the 2012 plan, the Navy envisions buying 205 combat ships—aircraft carriers, submarines, large and small surface combatants, and amphibious warfare ships—between 2012 and 2041. That total is seven ships more than under the 2011 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 2012–2041 period.

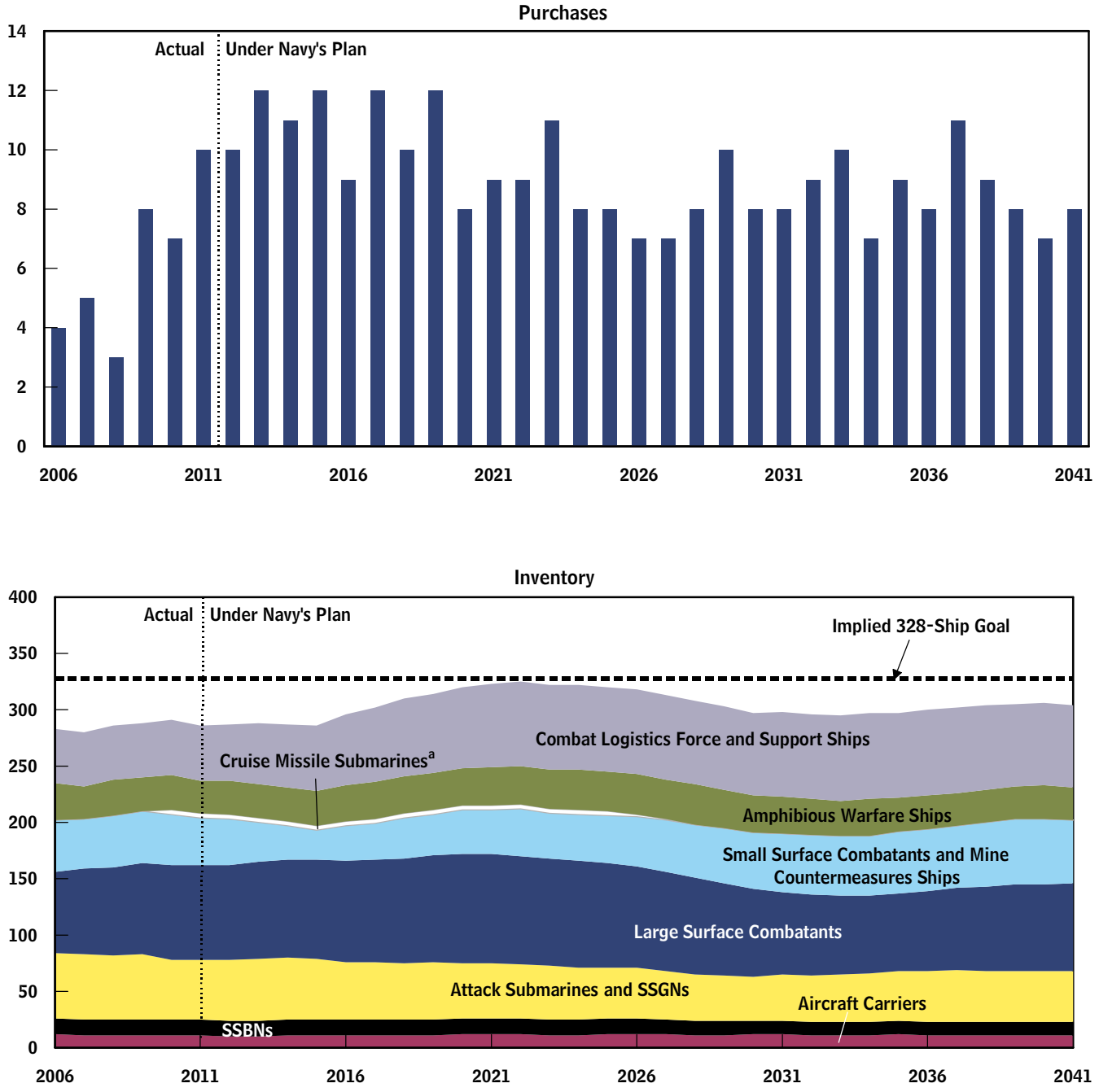
With aircraft carriers, by contrast, the Navy would meet or exceed its goal of 11 ships throughout the 2012–2041 time frame, except for the three-year period from 2013 to 2015. With respect to small surface combatants, the Navy plans to replace its frigates and mine countermeasures ships with littoral combat ships, although it would not reach its objective of having 55 such ships in the fleet until 2035.

Attack Submarines. Under the 2012 plan, the Navy would purchase 44 attack submarines through 2041, which would not be enough to keep that force up to the stated goal of 48 after 2024 (see Figure 3 on page 6). The number of attack submarines would reach a low of 39 in 2030 and then increase to about 45 for the last five years of the plan. The reason for the decline is that in 2015, the Navy expects to begin retiring Los Angeles class attack submarines (SSN-688s)—which were generally built at rates of three or four 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 at rates of one or two per year.

Large Surface Combatants. In 2010, the Navy decided not to develop and procure the CG(X) future cruiser, which was supposed to replace existing cruisers that are due to be retired in the 2020s. Instead, the current shipbuilding plan calls for buying 52 destroyers based on the existing Arleigh Burke class destroyer (DDG-51). Those purchases would allow the Navy's inventory of large surface combatants to meet the implied goal of 94 ships for a brief period between 2019 and 2024. After that, however, the inventory of large surface combatants would fall to a low of 68 in 2034 before increasing to the high-70s by

Figure 1.

Annual Ship Purchases and Inventories Under the Navy's 2012 Plan



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

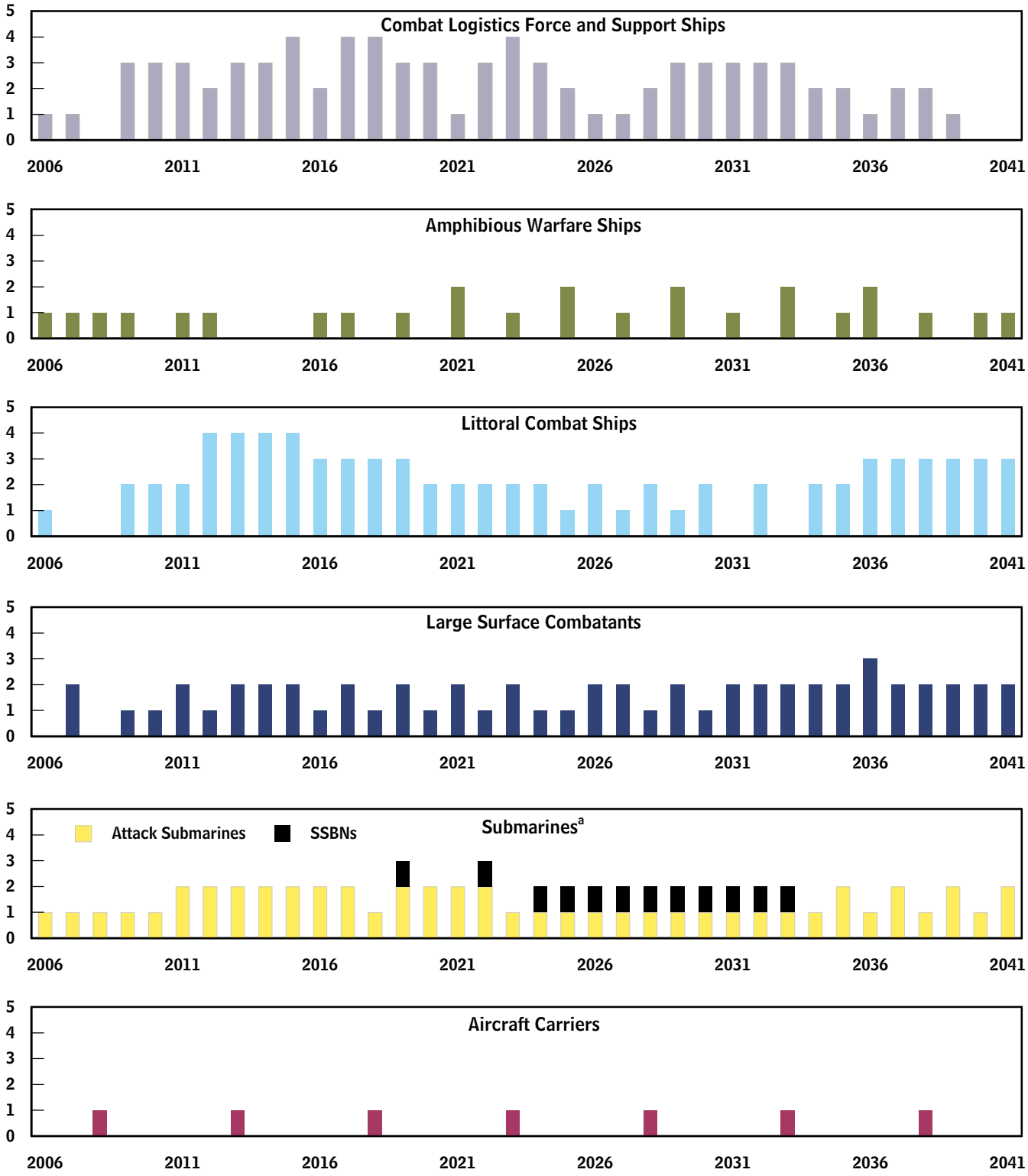
Note: Small surface combatants and mine countermeasures ships include littoral combat ships, Oliver Hazard Perry FFG-7 frigates, and Avenger class mine ships.

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

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

Figure 2.

Annual Ship Purchases, by Category, Under the Navy's 2012 Plan



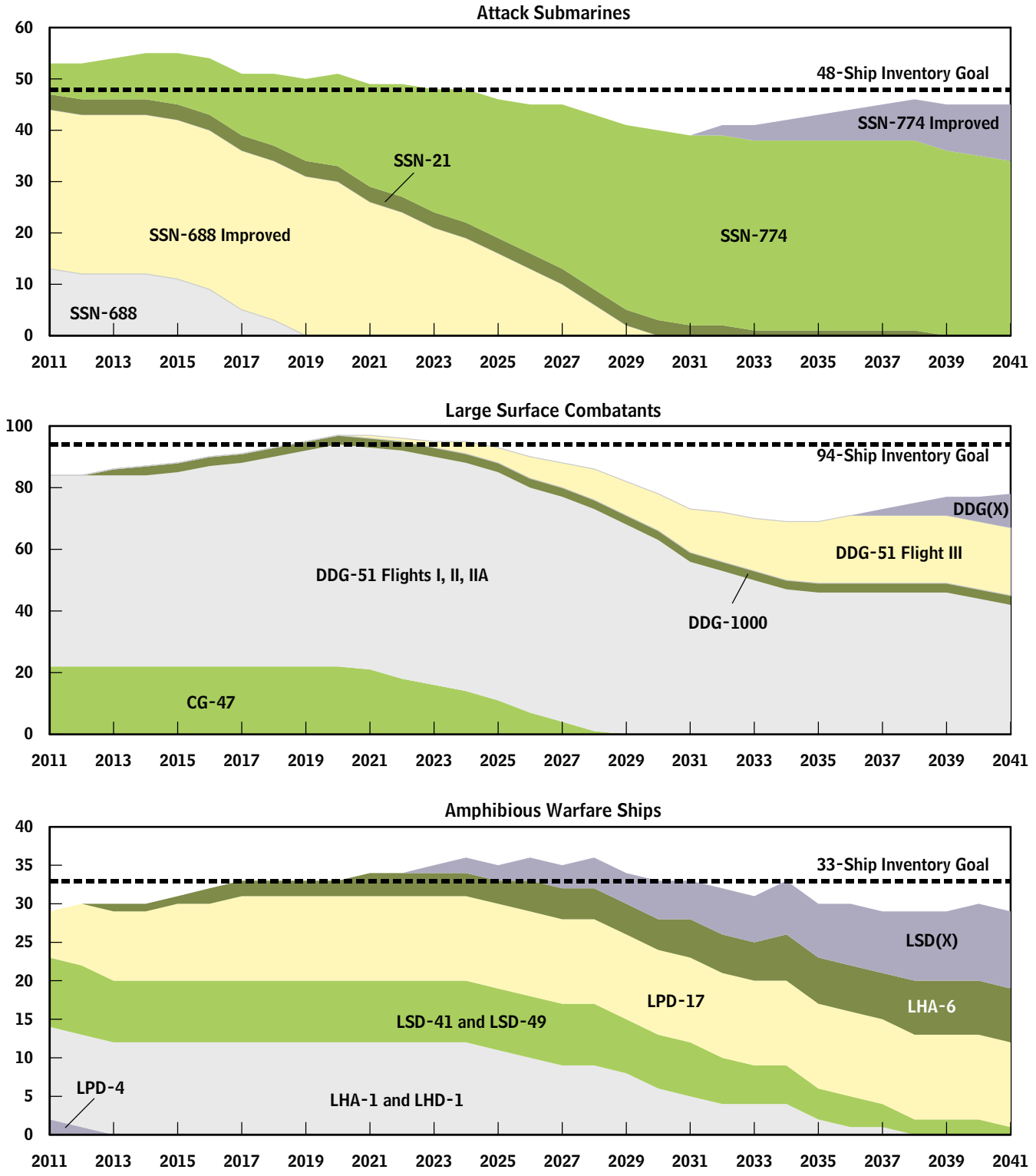
Source: Congressional Budget Office based on data from the Department of the Navy.

Note: SSBNs = ballistic missile submarines.

a. Although cruise missile submarines and 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 2012 Plan



Source: Congressional Budget Office.

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

2041. As with the attack submarine force, the decline in the number of large surface combatants would occur because the Navy would begin retiring Ticonderoga class cruisers (CG-47s) in the early 2020s and DDG-51s in the late 2020s at a faster pace than their replacements would be commissioned.

That plan for large surface combatants represents a continuation of the decisions made for the 2011 shipbuilding plan. In addition, the assumptions about the service life of large surface combatants remain the same under the 2012 plan. The 2011 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.[10]

Amphibious Warfare Ships. The current long-term plan calls for buying 20 amphibious warfare ships through 2041, which would increase the amphibious force from 31 ships today to the current goal of 33 by 2017. The force would stay at that size or greater through 2031 and then decline to 29 or 30 ships after 2035.

Under the 2011 plan, the Navy would also have purchased 20 amphibious warfare ships over three decades, but the plan assumed that the Navy would meet its inventory goal in 2016. Delays in the construction of the LHA-6 amphibious assault ship will postpone meeting the inventory objective by one year.

Logistics and Support Ships

In its 2012 plan, the Navy envisions buying 70 logistics and support ships in the next three decades—8 fewer than in the 2011 plan, or a decrease of about 10 percent. Those planned purchases include 19 new oilers (which provide fuel and a few other supplies to ships at sea) and 41 joint high-speed vessels. According to the Navy, the JHSVs are in great demand by regional combatant commanders. They may also be useful for other missions, such as engagement with friendly nations (through visits, training, and joint exercises) and some kinds of maritime security operations. The 2012 plan implies a new goal of 21 JHSVs, compared with 23 previously. (Purchases under that 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 2030.)

The change in the plan for JHSVs is more substantial than the numbers would suggest at first glance. Under the 2011 plan, the Navy's objective was to have 23 JHSVs for its own missions. However, changes in the way the Navy would operate those ships—giving them to the Military Sealift Command—allowed the service to reduce its own goal to 16 ships. The Navy will also soon start operating five JHSVs that are being purchased by the Army, which the Navy counts in its inventory of battle force ships. CBO assumed that the Navy would replace the Army JHSVs when they retired in the 2030s and that the Army would provide the necessary funding. Once the initial JHSVs were built by 2021, the Navy would meet its implied inventory goals for logistics and support ships through the end of the 30-year period.

A change in the Navy's T-AO(X) oiler replacement program eliminated a shortfall that would have occurred in combat logistics ships under the 2011 plan. Those 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. Under the 2012 plan, the new oilers would be bought starting in 2014 at a rate of one per year. The program would conclude in 2032. Under the 2011 plan, the Navy would have purchased the first oiler in 2017 and, because the Navy would not purchase an oiler in some years, would not have concluded the program until 2039.

The Navy also extended the service life of its two command ships by 10 years. They are now expected to retire in 2039, compared with 2029 under the 2011 plan.

Ship Costs Under the 2012 Plan

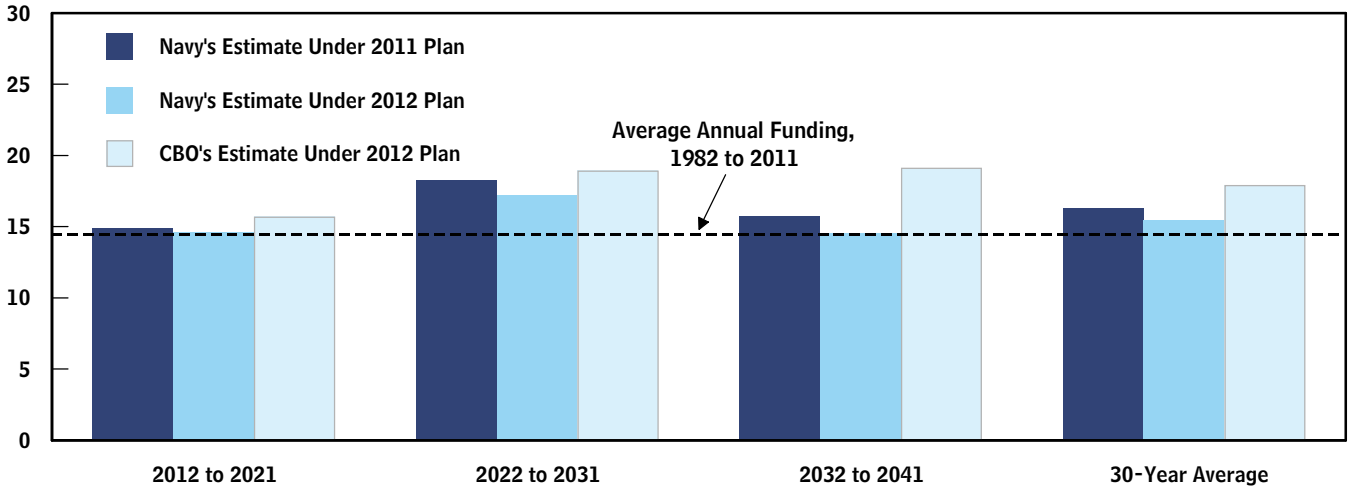
According to the Navy's estimates, carrying out its planned purchases would cost an average of $15.4 billion per year through 2041—6 percent less than the $16.3 billion under its 2011 plan. For estimating

10. The Navy built the Arleigh Burke class destroyers to last 35 years. However, the average retirement age of the past 13 classes of cruisers and destroyers has been well below that, 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 Navy retired those ships because of budgetary reasons, because they reached the end of their service life, or because improving their combat capabilities to meet existing threats was not cost-effective. 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, House Committee on Armed Services, *The Navy's Surface Combatant Programs* (July 31, 2008).

Figure 4.

Average Annual Costs of New-Ship Construction Under the Navy's 2011 and 2012 Plans

(Billions of 2011 dollars)



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

Notes: The Navy's estimate under the 2011 plan refers to the years 2011 to 2040.

The costs to construct new ships exclude the costs of refueling existing nuclear-powered aircraft carriers as well as outfitting and postdelivery costs (which cover various activities and small items, such as tools and equipment, that a ship needs to operate but that are not necessarily provided by the shipyard when the ship is built).

purposes, the Navy divided the time frame of the 2012 plan into three periods: near term (2012 to 2021), midterm (2022 to 2031), and far term (2032 to 2041). CBO also estimated the costs of the 2012 plan, using its own cost assumptions about Navy ships, which are explained in detail later in this study. Overall, CBO's estimates are about 16 percent higher than the Navy's, but the differences are smaller for the near term 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 nearly $2 billion per year, leaving CBO's estimates of that full cost about 15 percent above the Navy's corresponding figures.

The Navy's Estimates

The text of the Navy's shipbuilding report last year offered 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 estimating periods. For the near term, the report explained that "given known ship capability and quantity requirements, the cost estimates are judged to be accurate in this period." For the midterm, "the accuracy of the cost estimates diminishes for the force structure estimates in this timeframe." And for the far term, "the cost estimates are notional due to the uncertainty of business conditions affecting the shipbuilding industry."[11]

According to this year's plan, in the near term, building new ships will cost an average of $14.6 billion per year (see Table 2). In the midterm, replacing the Navy's current Ohio class ballistic missile submarines drives up the average cost of new-ship construction to $17.2 billion per year. In the far term, the Navy's estimated costs fall to an average of $14.7 billion. As the Navy acknowledges, the precision of those estimates diminishes as the time spans go farther into the future.

11. Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011,* pp. 9–10.

Table 2.

Average Annual Shipbuilding Costs Under the Navy's 2012 Plan, by Decade

	Near Term (2012–2021)	Midterm (2022–2031)	Far Term (2032–2041)	Total (2012–2041)
	Navy's Estimates (Billions of 2011 dollars)			
New-Ship Construction[a]	14.6	17.2	14.7	15.5
New-Ship Construction plus Refueling of Nuclear-Powered Aircraft Carriers[b]	15.8	18.1	15.8	16.6
New-Ship Construction, Refueling of Nuclear-Powered Aircraft Carriers, and Outfitting and Postdelivery Costs[b]	16.4	19.0	16.4	17.3
	CBO's Estimates (Billions of 2011 dollars)			
New-Ship Construction	15.7	19.0	19.2	18.0
New-Ship Construction plus Refueling of Nuclear-Powered Aircraft Carriers	16.9	19.9	20.3	19.0
New-Ship Construction, Refueling of Nuclear-Powered Aircraft Carriers, and Outfitting and Postdelivery Costs	17.5	20.8	21.1	19.8
	Percentage Difference Between CBO's and the Navy's Estimates			
New-Ship Construction	7	10	31	16
New-Ship Construction plus Refueling of Nuclear-Powered Aircraft Carriers	7	10	29	15
New-Ship Construction, Refueling of Nuclear-Powered Aircraft Carriers, and Outfitting and Postdelivery Costs	7	9	28	15
Memorandum:				
CBO's Estimates of the Cost to Fully Fund the Navy's Goal of a Fleet of 328 Ships[c]	19.1	21.3	18.6	19.7
Additional Costs of Mission Packages for Littoral Combat Ships	0.3	0.2	0.3	0.3

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

Note: Actual costs for the Navy's shipbuilding accounts over the past 30 years averaged about $15.6 billion per year for all items. Between 2006 and 2011, costs for new-ship construction averaged $12.0 billion annually; costs for new-ship construction and nuclear refuelings averaged $12.5 billion; and costs for new-ship construction, nuclear refuelings, and outfitting and postdelivery expenses averaged $12.9 billion per year. Outfitting and postdelivery costs cover various activities and small items, such as tools and equipment, that a ship needs to operate but that are not necessarily provided by the shipyard when the ship is built.

a. CBO adjusted the Navy's estimate to reflect the service's official cost estimate for the SSBN(X) ballistic missile submarine.

b. These numbers represent the Navy's estimate for new-ship construction plus CBO's estimate for additional costs.

c. Includes new construction only.

As in previous shipbuilding plans, the Navy's latest cost estimates exclude other items that the service would need to fund from its budget accounts for ship construction:[12]

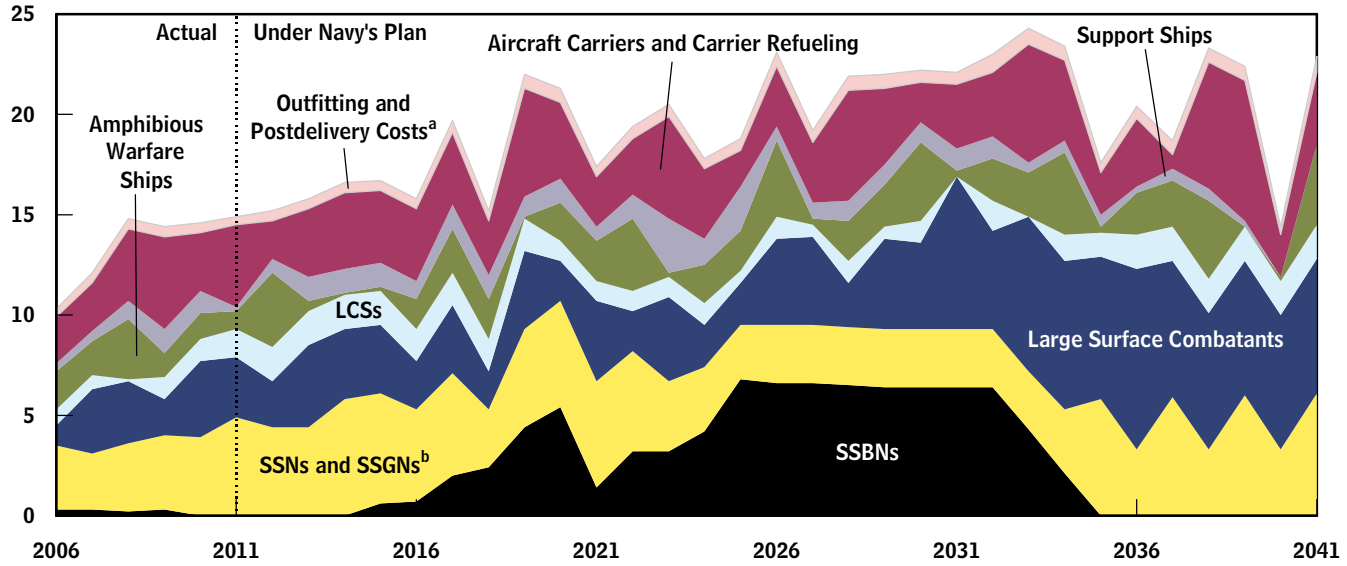
- Refueling of nuclear-powered aircraft carriers, whose reactors are replaced midway through the ships' service life; and
- Outfitting and postdelivery costs, which cover various activities and small items, such as tools and

12. 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.

Figure 5.

CBO's Estimate of Annual Total Shipbuilding Costs Implied by the Navy's 2012 Plan

(Billions of 2011 dollars)



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

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

a. Outfitting and postdelivery costs cover various activities and equipment that a ship needs to operate but that are not necessarily provided by the shipyard when the ship is built.

b. Costs for SSGNs refer only to those in the 2006–2011 period.

equipment, that a ship needs to operate but that are not necessarily provided by the shipyard when the ship is built.[13] Over the past 15 years, outfitting and postdelivery costs have equaled about 3.2 percent of the Navy's total budget for new construction and for refueling of submarines and aircraft carriers.

Including the costs of refueling carriers would increase the Navy's budget estimate for the 2012 plan to an average of $16.6 billion a year through 2041, CBO estimates.[14] Adding outfitting and postdelivery costs, and other small items, would raise that amount to $17.3 billion per year. That figure for the full cost of the 2012 shipbuilding plan is about 11 percent higher than the average funding that the Navy has received in the past three decades—about $15.6 billion per year.

CBO's Estimates

The full cost of the 2012 shipbuilding plan, in CBO's estimation, would average $19.8 billion over the 2012–2041 period—about 15 percent more than the Navy's estimate of $17.3 billion and about 27 percent more than the average funding the Navy has received in the past three decades. CBO's numbers are only about 7 percent higher than the Navy's for the first 10 years of the plan but 28 percent higher for the last 10 years of the plan. Those costs exhibit a fair amount of variation year by year but trend upward for the first two decades of the

13. Outfitting costs exclude the costs of fuel, food, and ammunition.

14. That number represents the Navy's estimate for new construction plus CBO's estimate for refueling aircraft carriers. It also includes CBO's estimate of the costs to extend the service life of existing air-cushion landing craft—known as LCACs—and to buy their replacements; together, those LCAC costs average about $200 million per year. In 2010, the Navy transferred funding for refueling nuclear-powered submarines to a procurement account (Other Procurement, Navy, or OPN) that is not used to purchase ships. Thus, CBO did not include the refueling costs for submarines in its estimates of shipbuilding costs.

plan (see Figure 5). Looking at the 30-year period as a whole and adding up the various cost components, CBO estimated the following:

- Costs for new-ship construction alone would average $18.0 billion per year, 16 percent greater than the Navy's figure of $15.5 billion.
- New-ship construction plus refueling of nuclear-powered aircraft carriers would cost an average of $19.0 billion per year, 15 percent greater than the Navy's figure of $16.6 billion.
- Outfitting and postdelivery, and some other small items, would add annual costs of about $800 million, raising CBO's estimate to an average of $19.8 billion per year through 2041, 15 percent greater than the Navy's figure of $17.3 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. Looking farther ahead, 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 1). 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. However, because projections for long-term inflation in the shipbuilding industry have declined, while CBO's projection for inflation in the economy as a whole has increased, the difference in the last decade of the plan is less pronounced in this analysis than in CBO's analysis last year of the Navy's 2011 shipbuilding plan.

The Costs of Fully Funding the 328-Ship Fleet

As explained above, under its 2012 shipbuilding plan, the Navy would not build the appropriate number of ships at the right times to meet the service's 328-ship inventory goal. In particular, the plan would lead to shortfalls relative to the Navy's goals in attack submarines, large surface combatants, and amphibious warfare ships.

Those shortfalls could be avoided by making several changes to the current plan:

- To prevent the attack submarine force from falling below the inventory goal of 48, the Navy could purchase a total of 5 additional submarines. Specifically, it would purchase nine additional attack submarines from 2014 through 2018 and in 2020, 2023, and 2024, increasing the production rate to three subs per year between 2013 and 2024. If that occurred, the Navy could buy four fewer attack submarines during the 2030s and 2040s than is called for under the Navy's plan while still maintaining the desired inventory level.
- To maintain its desired force of at least 94 large surface combatants after 2024, the Navy could purchase 24 additional destroyers between 2012 and 2029, increasing the production rate to three ships per year.
- To preclude a shortfall in amphibious warfare ships relative to the Navy's goal, the LHA-6 class amphibious assault ships could be purchased at a rate of one every three years, instead of one every four or five years as in the Navy's plan. (The Navy's 2007, 2008, and 2009 shipbuilding plans called for purchasing those types of ships every three years.) That faster pace would add two additional amphibious warfare ships to the plan and produce six ships earlier. If two LSD(X)s were also purchased earlier than the Navy intends, then a shortfall would be avoided.

According to CBO's estimates, incorporating those changes into the Navy's plan would raise the average annual budget for new-ship construction between 2012 and 2041 from $18.0 billion to $19.7 billion (see Table 2 on page 9).

Other approaches to forestalling shortfalls to the 328-ship inventory goal could have different costs. For example, if the Navy was able to extend the service life of some existing ships, fewer additional ships would be needed, and costs would probably be lower. However, the Navy's plan already assumes that most destroyers would be in service for 40 years, longer than any surface combatant has served in the Navy's fleet in at least the last 30 years. Consequently, CBO did not make the assumption that those ships could be made to serve for an even longer period of time in order to prevent the shortfall in large surface combatants.

Box 1.

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 shipbuilding index that reflects the growth in the costs of labor and materials that the industry has experienced in the past. The service developed that index using a weighted composite of annual percentage changes in the costs of labor and materials specific to shipbuilding, based on shipyards' data about labor costs in the past, advance pricing agreements, vendor surveys, and projections of the cost of materials from the Bureau of Labor Statistics.

From 2011 through at least 2016, the Navy's index is projected to grow at an average annual rate of 3.1 percent. By comparison, the gross domestic product (GDP) price index, which measures the prices of final goods and services in the economy, will grow at an average annual rate of 1.6 percent, in CBO's estimation. The difference between the two rates implies that annual inflation will be 1.5 percentage points higher for shipbuilding programs during that period than for the economy as a whole. That represents a significant narrowing of the gap that existed when CBO published its analysis of the Navy's 2011 plan in May 2010, when the difference was 1.9 percentage points. Since 1981, the historical average of the gap has been about 1.4 percentage points (see the figure to the right).

The Navy incorporated that higher rate of shipbuilding inflation into its budget request for 2012 and into the associated Future Years Defense Program. But in projecting its constant-dollar estimates for the 2012 shipbuilding plan, the Navy did not assume that the higher inflation rate would drive the costs of future shipbuilding programs. Instead, it assumed that, in constant dollars, a ship that cost $2.5 billion to build in 2011 would cost the same (in 2011 dollars) to build in 2020 or 2030.

Continued

Outlook for Individual Ship Programs

To estimate the costs of implementing the Navy's plan, CBO calculated the cost of each of the 275 ships that the Navy intends to purchase from 2012 through 2041. 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 individual ship costs in this section exclude outfitting and postdelivery costs.

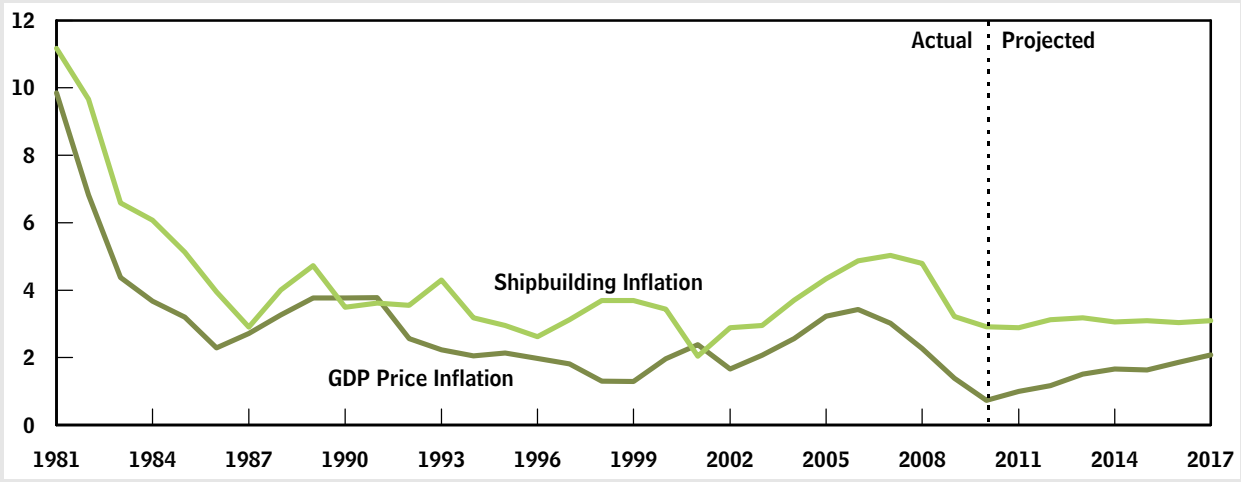
Aircraft Carriers

The 2012 shipbuilding plan clarifies that the Navy's goal is to have 11 aircraft carriers, compared with the 10 to 11 cited in the 2011 plan. The Navy intends to buy six CVN-78 Gerald R. Ford class aircraft carriers over the 2012–2041 period. Building one carrier every five years (commonly referred to as "five-year centers") would enable the Navy to have a force of at least 11 carriers almost continuously through 2041. The exception would be in 2013 and 2014, when the number of carriers would

Box 1. **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.

In its estimates, CBO assumed 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. Specifically, CBO assumed that shipbuilding inflation would outpace inflation as measured by the GDP price index by 1.5 percentage points between 2011 and 2016 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 2011 would cost $3.3 billion (in 2011 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.

drop to 10. That temporary decline would occur because the USS *Enterprise* (CVN-65) is scheduled to be retired in 2013—after 52 years of service—but the next new carrier, the USS *Gerald R. Ford* (CVN-78), would not be commissioned until 2015. Any delays in building the new CVN-78 class would extend the period during which the Navy had only 10 carriers.

The Navy's projected cost of the lead ship of the CVN-78 class grew by 10 percent between the President's 2008 and 2012 budget requests. The Navy's budget now projects the lead ship's cost to be about $12.0 billion (about what CBO estimated in its analysis of the Navy's 2009 plan). However, further increases appear likely. According to the Selected Acquisition Report for the CVN-78 program, the program manager is currently estimating an additional $600 million in cost overruns above the budgeted amount. In addition, the lead ship of the CVN-78 class is only about 23 percent complete, and cost growth in shipbuilding programs typically occurs when a ship is more than half finished—particularly in the later stages of construction, when all of a ship's systems must be installed and integrated. Therefore, greater cost growth in the lead ship appears likely, which would signal higher costs for subsequent ships in the class as well.

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). As a result, CBO estimates that the lead CVN-78 will cost about $12.9 billion once it is completed. Subsequent ships of the 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 six carriers in the 2012 plan at $12.1 billion, whereas the Navy estimates their average cost at $10.3 billion (see Table 3). CBO's estimate for all carriers under the 2012 plan is lower than the estimate for the 2011 plan primarily because (as discussed in Box 1) the projected gap between inflation in the economy overall and long-run shipbuilding inflation has narrowed.

There are several reasons to believe that the final cost of the CVN-78 could be even higher than CBO's estimate. First, most lead ships built in the past 20 years have experienced cost growth of more than 40 percent. (CBO's estimate for the lead CVN-78 accounts for some but not all of that historical cost growth.) Second, Navy officials have told CBO that they have budgeted to the 40th percentile of possible cost outcomes. That is, there is a 60 percent probability that the final cost of the CVN-78 will exceed the service's estimate and only a 40 percent probability that the final cost will be less than that estimate. 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. Difficulties in completing their development could arise and increase costs, which would also affect the costs for subsequent ships of the class.

Submarines

Under the 2012 shipbuilding plan, submarines would overtake surface combatants as the largest source of demand for shipbuilding funds over the next 30 years (see Table 4). 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 2019; buy 23 Virginia class attack submarines at a rate of mostly two per year through 2024; and buy submarines based on a redesign and improvement of the Virginia class, with production of the new version to start in 2025. The Navy does not plan to replace its four SSGNs when they retire 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. The Navy's 2007 and 2008 shipbuilding plans included an assumption that the first SSBN(X) would cost $4.6 billion (in 2011 dollars) and that subsequent ships in the class would cost about $3.5 billion apiece.[15] The 2011 plan, in contrast, estimated the costs of the SSBN(X) class at an average of $7.4 billion. That figure highlights the great expense of replacing current ballistic missile submarines and the effect that effort could have on other shipbuilding programs or programs beyond shipbuilding.[16] Under the 2012 plan, the first SSBN(X) would be authorized in 2019 (although advance procurement money would be needed starting in 2015 for items with long lead times). The second submarine would be purchased in 2022, followed by one per year from 2024 to 2033.

Over the past year, the Navy has sought to refine its SSBN(X) design, particularly to 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 in today's industry conditions and with today's technology. The Navy states that it was able to reduce the estimated cost of the SSBN(X) between 2011 and 2012 by making the following changes:

15. For more about how the Navy arrived at those estimates, see Congressional Budget Office, "Resource Implications of the Navy's Fiscal Year 2008 Shipbuilding Plan," attachment to a letter to the Honorable Gene Taylor (March 23, 2007), pp. 8–9.

16. The Navy's 2009 shipbuilding plan excluded the costs of the SSBN(X).

Table 3.

Comparison of the Navy's and CBO's Estimates for Major New Ships

(Billions of 2011 dollars)

	Number of Ships Purchased Under the 2012 Plan	Total Costs per Class over the 2012–2041 Period		Average Cost per Ship over the 2012–2041 Period		Memorandum: Average Ship Costs Under the 2011 Plan	
		Navy's Estimate	CBO's Estimate	Navy's Estimate	CBO's Estimate	Navy's Estimate	CBO's Estimate
CVN-78 Gerald R. Ford Class Aircraft Carriers	6	62 [a]	75 [a]	10.3 [a]	12.1 [a]	10.9	12.5
SSBN(X) Ballistic Missile Submarines (Replacements for Ohio class)	12	75 [b]	86	6.1 [b]	7.2	7.4	8.3
Virginia Class Attack Submarines	23	58	59	2.5	2.6	2.5	2.6
Improved Virginia Class Attack Submarines (Replacements for Virginia class)	21	62	64	3.0	3.0	3.0	3.3
DDG-51 Arleigh Burke Class Destroyers							
Flight IIA	9	13	15	1.5	1.7	1.6	1.8
Flight III	22	52	47	2.3	2.1	2.1	2.4
DDG(X) Destroyers (Replacements for Arleigh Burke class)	21	45	75	2.1	3.6	2.5	4.0
Littoral Combat Ships	47	24	24	0.5	0.5	0.6	0.6
LCS(X)s (Replacements for littoral combat ships)	24	10	15	0.5	0.6	0.6	0.7
LSD(X) Amphibious Dock Landing Ships	11	14	18	1.3	1.6	1.3	1.8
LHA-6 Amphibious Assault Ships	7	24 [c]	29 [c]	3.8 [c]	4.1 [c]	3.5	4.3

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

a. In CBO's and the Navy's estimates for aircraft carriers, total costs per class include remaining funds for the CVN-78 as well as advance procurement funding for the carrier the Navy plans to buy in 2043. CBO's and the Navy's average ship cost excludes that funding but includes advance procurement funding for the CVN-79 that was appropriated before 2012.

b. The Navy's estimates for the SSBN(X) reflect the service's official cost estimates for the program.

c. Total funding for the LHA-6 class excludes amounts that would be funded in 2042 for the ship authorized in 2041. However, CBO's and the Navy's average ship cost includes those amounts but excludes remaining funds for the ship authorized in 2011.

Table 4.

Total Shipbuilding Costs, by Major Category, 1982 to 2041

	Historical				CBO's Estimate Under the Navy's 2012 Plan			
	1982–1991	1992–2001	2002–2011	1982–2011	2012–2021	2022–2031	2032–2041	2012–2041
	Average Annual Costs (Billions of 2011 dollars)							
Aircraft Carriers	3.0	2.1	2.6	2.6	3.6	3.5	4.0	3.7
Submarines	7.5	2.2	4.2	4.6	6.7	9.1	5.7	7.2
Surface Combatants	7.7	5.0	4.2	5.7	4.8	4.8	8.8	6.1
Amphibious Ships	1.7	1.2	1.8	1.6	1.5	2.1	2.2	1.9
Support Ships	2.2	0.6	0.7	1.2	1.0	1.3	0.5	1.0
Total	**22.0**	**11.1**	**13.6**	**15.6**	**17.5**	**20.8**	**21.1**	**19.8**
	Percentage of Average Annual Costs							
Aircraft Carriers	13	19	19	16	20	17	19	19
Submarines	34	19	31	30	38	44	27	36
Surface Combatants	35	45	31	36	27	23	41	31
Amphibious Ships	8	11	13	10	8	10	10	10
Support Ships	10	5	5	7	6	6	2	5
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Congressional Budget Office.

Note: The amounts shown here are for construction of new ships, refueling of nuclear-powered aircraft carriers, and outfitting and postdelivery (which cover various activities and small items, such as tools and equipment, that a ship needs to operate but that are not necessarily provided by the shipyard when the ship is built).

- Using a less expensive basic design (with greater specificity, eliminating some costs in last year's estimate 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, the capability of various arrays, and the sail mast; and
- Increasing the use of Virginia class components.[17]

Despite those changes, the Navy's estimate of the cost of the lead SSBN(X) increased between 2011 and 2012, from $9.0 billion to $11.6 billion. However, the Navy's estimate of the average cost of follow-on ships decreased from $6.9 billion to $5.8 billion, and the Navy has stated an objective of reducing that cost to $5.0 billion.[18] All told, the Navy estimates that building 12 of the submarines would cost $75 billion, or an average of $6.1 billion each.[19]

In comparison, CBO estimates that the lead SSBN(X) will cost about $13.3 billion on the basis of its scheduled purchase in 2019. Estimating the cost of the first

17. 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, House Committee on Armed Services, *The Long-Term Outlook for the U.S. Navy's Fleet* (January 20, 2010).

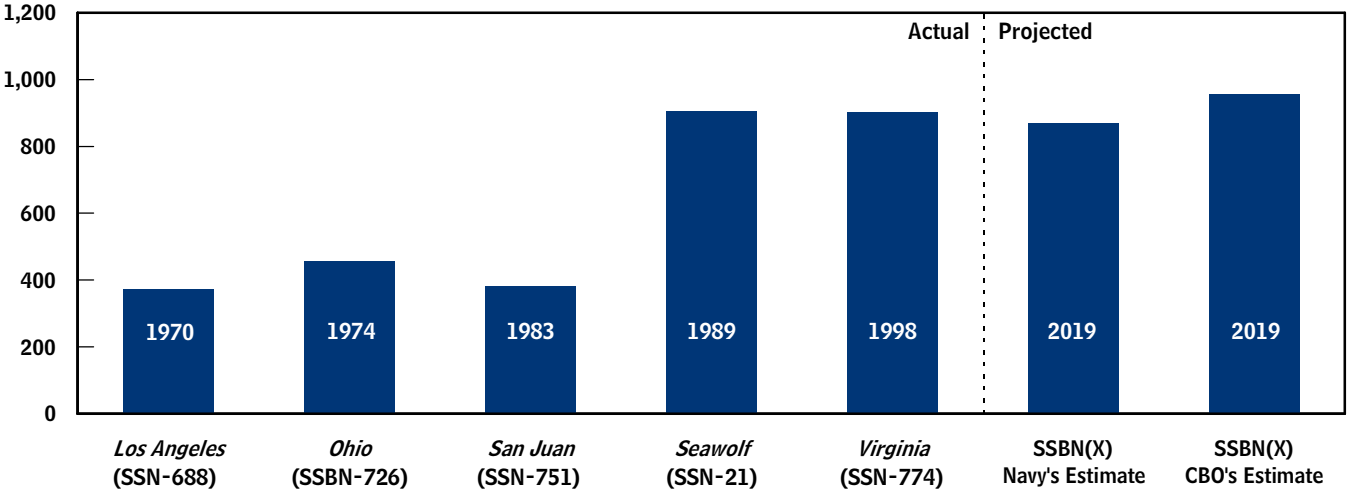
18. Navy briefing to the staff of the House Armed Services Committee, CBO, and the Congressional Research Service, February 28, 2011.

19. The estimate was presented in fiscal year 2010 dollars: $11.6 billion for the lead SSBN(X) and $5.6 billion for the remaining ships, with the objective of reducing the cost of those ships to $4.9 billion each. CBO adjusted those estimates to 2011 dollars for comparability.

Figure 6.

Cost per Thousand Tons for the Lead Ship of Various Classes of Submarines

(Millions of 2011 dollars)



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

Notes: The years shown here indicate the year in which each lead submarine (the first of each class to be built) was or will be authorized.

Costs are per thousand tons of estimated final Condition A-1 displacement (the weight of the ship complete, ready for service in every respect, including onboard repair parts and liquids in machinery at operating levels, but without any solid ballast, liquid ballast, or residual water).

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 on a per-ton basis between a lead attack submarine (SSN) and a lead SSBN (see Figure 6). 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 increase in the Navy's estimate for the lead SSBN(X) reflects the fact that the service now also estimates that nonrecurring costs will be about $5 billion. Under the 2011 plan, the Navy appeared to assume that those costs would be about $2 billion.

Overall, 12 SSBN(X)s would cost a total of about $86 billion in CBO's estimation, or an average of $7.2 billion each. That average includes the $13.3 billion estimated cost of the lead ship and a $6.5 billion average estimated cost for the 2nd through 12th ships. Research and development would cost another $10 billion to $15 billion, for a total program cost of $96 billion to $101 billion. CBO's estimate under the 2011 plan was an average of $8.3 billion per submarine. The decline in CBO's estimate stems from two factors: the changes in the Navy's design and the narrowing of the projected gap between inflation in the economy overall and inflation in the shipbuilding industry.[20] The change in design accounts for about 60 percent of the reduction in cost, and the change in the projected inflation differential accounts for the remainder.

Attack Submarines. Under the 2012 plan, the Navy would buy 23 Virginia class attack submarines at a rate of two per year from 2012 through 2022, with the exceptions of 2018, 2023, and 2024, when the Navy would buy one per year. Starting in 2025, the Navy would buy the improved Virginia class at a rate of one SSN annually in most years until 2041. With such a procurement

20. As Box 1 on page 12 indicates, CBO now projects that the gap between GDP inflation and shipbuilding inflation will be close to the 30-year historical average. That average is a little less than the gap CBO projected in its analysis of the Navy's 2011 shipbuilding plan.

schedule, the attack submarine force would remain at or above the Navy's goal of 48 through 2023 but then fall to between 39 and 46 submarines thereafter (see Figure 3 on page 6).

Senior Navy leaders have stated—and the 2012 plan assumes—that Virginia class SSNs would have to cost $2.5 billion or less for the Navy to be able to afford two per year.[21] The President's 2011 budget indicates a cost of about $2.5 billion. According to the Navy's estimates, the total cost for all of the Virginia class submarines purchased between 2011 and 2024 would be about $58 billion, whereas according to CBO's estimates, the total cost would be slightly higher, at $59 billion.

The Navy assumed under both the 2011 and 2012 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 that the average cost of the improved Virginia class would be about $3.0 billion, or the same as under the Navy's plan.

Large Surface Combatants

The Navy has made few changes to its procurement plans for cruisers and destroyers since the 2011 plan was issued. The Navy is proceeding with its plans to restart production of DDG-51 destroyers, with the first ship funded in the 2010 budget, two more in 2011, and nine more planned for 2012 to 2017. Beginning with one ship in 2016, skipping 2017, and then continuing in 2018 and beyond, new DDG-51s would have an upgraded design, a configuration known as Flight III. And in 2032, the Navy would start purchasing the DDG(X), 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 94 large surface combatants through 2024, although the force would fall below that number thereafter (see Figure 3 on page 6).

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 small-boat attacks). The next 34 ships were designated Flight IIA, which included a hangar and thus the ability to carry two helicopters or several ship-launched unmanned aerial vehicles.[22]

Under the Navy's 2012 plan, the new DDG-51s purchased through 2015 and in 2017 would use the Flight IIA configuration but also incorporate the latest ballistic missile defense capabilities.[23] Those ships would have an average cost of about $1.7 billion in CBO's estimation—about $200 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—as well as to replace Ticonderoga class cruisers when they are retired in the 2020s—is to modify the design of the DDG-51 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

21. Specifically, the Navy has said that to purchase two Virginia class submarines a year, their cost would have to decline to $2.0 billion each in 2005 dollars, which is equivalent to about $2.5 billion in 2011 dollars.

22. 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. (Washington, D.C.: Naval Institute Press, 2005), pp. 147–152.

23. The Navy has announced that all existing DDG-51s will eventually be equipped with improved ballistic missile defenses; up to 23 of those upgrades will have been funded by the end of 2011. 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 3, 2011).

operate the radar effectively.[24] Those changes, along with associated increases in the ship's displacement, would make a DDG-51 Flight III cost $400 million, or about 25 percent, more than a new Flight IIA, by CBO's estimate.[25] Thus, CBO estimates that the average cost per ship would be $2.1 billion. Overall, the Navy plans to buy 22 DDG-51 Flight III ships between 2016 and 2031.

CBO's estimate of the cost of each of these ships is about $300 million less than it was last year. Most of the reduction in CBO's estimate was the result of adopting the assumption that the Navy would purchase the Flight III destroyers using multiyear procurement authority, as it did for all destroyers bought between 1998 and 2005.[26] Adopting that assumption reduced the cost of each ship by about 10 percent. At the same time, the Navy increased its estimate for the average price of a DDG-51 Flight III from $2.1 billion to $2.3 billion per ship. In an information paper to CBO and the Congressional Research Service, the Navy states that it is developing the design of the Flight III and, therefore, changing the cost estimate from the "initial rough order of magnitude initially presented in the 2011 report to Congress." The Navy's estimate at this stage, however, does not reflect the assumption that it would be using multiyear procurement authority to purchase those ships.

DDG(X) Future Guided Missile Destroyers. Like the Navy's 2011 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.[27] The 2011 plan designated those ships as the DDG(X), while the 2012 plan designates them as DDG-51 Flight IV. (For this discussion, CBO retains the DDG(X) designation.) Under the current plan, the start of the DDG(X) program would occur in 2032, 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 21 DDG(X)s at an average cost of $2.1 billion—$400 million less than its estimate for those ships under the 2011 plan. It is not clear why the Navy significantly reduced its estimate for those ships (while at the same time increasing its estimate for the DDG-51 Flight III), but that number appears to incorporate two assumptions: that the DDG(X) would cost the same as the DDG-51 Flight III if it were built in the same way, and that the Navy would build those ships in one shipyard rather than two. Under the plan, all of the DDG(X)s would be bought at a rate of two per year and, the Navy assumed, at a unit cost lower than that for a single DDG-51 Flight III. Therefore, the estimate seems to incorporate benefits from spreading the overhead costs of one shipyard across at least two ships in a given year. (Some of the DDG-51 Flight III destroyers are purchased at a rate of one per year and do not benefit from a rate effect, thus having a higher overall average price.) In addition, 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 2032, 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

24. 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 6, 2011).

25. 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.

26. 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 those ships that are covered by multiyear procurement.

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

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 $3.6 billion. That figure is about 70 percent greater than the Navy's current estimate. CBO assumed that those ships would be built at two shipyards, so the pricing does not benefit from spreading the overhead costs of a shipyard across multiple ships, except in 2036, when the Navy plans to order three of the ships.

Littoral Combat Ships

In the 2012 plan, the Navy envisions building a force of 55 littoral combat ships (LCSs) between 2005 and 2031. Because those ships are assumed to have a service life of 25 years, the Navy would need to begin procuring their replacements in 2032. 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 with the ability to switch mission packages depending on what mission the ship is intended to carry out at a given time. Currently, the Navy expects to use three types of mission packages: 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.[28]

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 $278 million, on average, in 2011 dollars (or $220 million in 2005 dollars). So far, two LCSs have been built, by different contractors using different designs. LCS-1, based on a semiplaning steel monohull, cost $570 million to build (not including $33 million invested by the contractor); LCS-2, based on an all-aluminum trimaran (basically, a three-hulled ship), cost $626 million. With outfitting and postdelivery costs added in, as well as 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 $740 million and $770 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. 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—two 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 so low—that the Navy 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.[29] Each shipyard will build two ships with funds appropriated in 2010 and 2011, and then two ships per year from 2012 to 2015 if further funds are appropriated.[30] 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. It could select one design for the remainder of the program, or it could hold another competition that included both designs. The

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

29. For 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).

30. 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 3, 2011).

Navy plans to see how well the existing shipyards perform in executing their contracts before deciding how to acquire the rest of the ships.

In the 2012 FYDP, the Navy estimated the average cost of the LCS at about $450 million per ship, reflecting a substantial savings over the $600 million that it had estimated under the 2011 FYDP. The current figure is well below the Congressionally mandated cost cap for the LCS program ($480 million per ship, adjusted for inflation).[31] According to the Navy, the new lower prices reflect the benefits of the competition the Navy held for the program last year. For ships purchased after 2015, the Navy assumed that they would cost about $540 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 get prices, adjusted for inflation, similar 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.

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 would get the same prices for the ships purchased after 2015. Therefore, CBO estimates the average per-ship cost of the 47 LCSs in the plan at about $500 million.

Besides the change in acquisition strategies that the Navy announced last fall, the 2012 shipbuilding plan shows essentially the same procurement rate for LCSs as under the previous plan. Under the 2011 plan, the Navy would purchase up to four LCSs a year between 2013 and 2015, three per year thereafter, and then one or two per year starting in 2020. Under the 2012 plan, the Navy would purchase one additional LCS in 2012 as part of the two 10-ship contracts and one fewer LCS in 2030. As a result, the service would not achieve a force of 55 LCSs until 2035.

The Navy would also buy 24 next-generation littoral combat ships—called LCS(X)s—beginning in 2032. The Navy's cost estimate for the LCS(X) under the 2012 plan is $500 million. CBO estimates the average cost of the LCS(X) at about $600 million per ship.

Amphibious Warfare Ships

In the 2011 shipbuilding plan, the Navy implied that its new goal for its amphibious force would be 33 ships, up from 31 previously.[32] The 2012 plan maintains the same procurement goal. The proposed force would consist of 11 LHA or LHD amphibious assault ships, 11 LPD amphibious transport docks, and 11 LSD dock landing ships. In pursuit of that force, the 2012 plan calls for buying seven LHA-6s, at a rate of one every four or five years, to replace LHD-1 class amphibious assault ships. The plan also envisions buying one more LPD-17 class amphibious transport dock (in 2012) and 11 LSD(X) dock landing ships (one every other year between 2017 and 2037) to replace existing dock landing ships in the classes LSD-41 and LSD-49. The 2012 plan would also start replacing the LPD-17 class with a new class beginning in 2040. With that procurement schedule, however, the total number of amphibious warfare ships would be below the implied 33-ship goal from 2011 to 2016 and again from 2032 to 2041.

The Navy's cost estimates for amphibious warfare ships have not changed significantly since the 2011 plan. In the 2012 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 $1.6 billion.

The Navy estimates that the LHA-6 class amphibious assault ships will cost $3.8 billion apiece. CBO's estimate for those ships is higher: an average of $4.1 billion per

31. The National Defense Authorization Act for Fiscal Year 2010 (Public Law 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 certain other circumstances.

32. Specifically, the report says that 33 is the minimum number of amphibious warfare ships needed for the "Assault Echelon in a 2 Marine Expeditionary Brigade forcible-entry operation"; see Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2011*, p. 15. The increase in the goal for amphibious warfare ships was not unexpected: The Navy's 2009 plan had suggested that the goal would be changed to 33 in the future.

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.