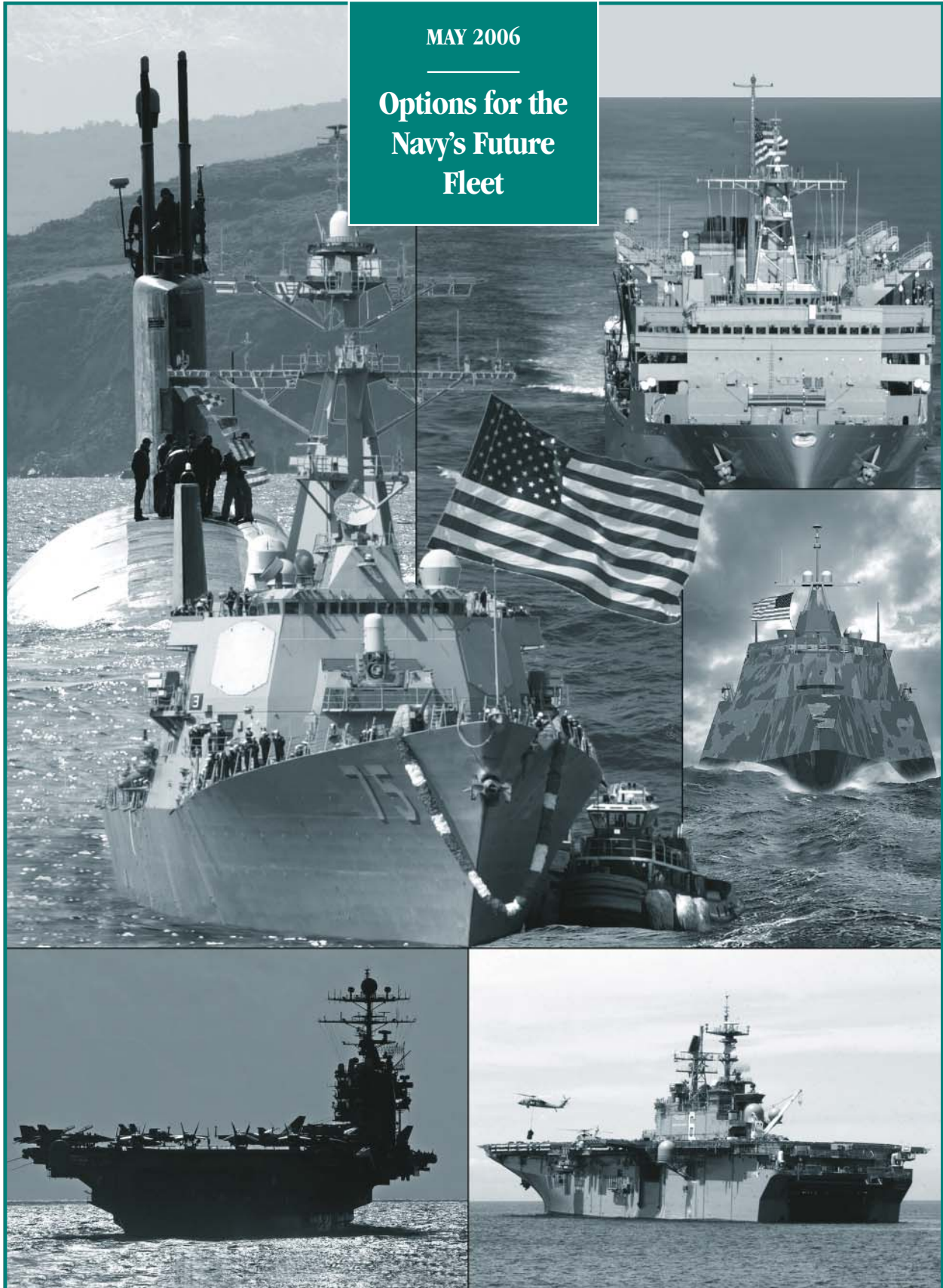


CONGRESS OF THE UNITED STATES
CONGRESSIONAL BUDGET OFFICE

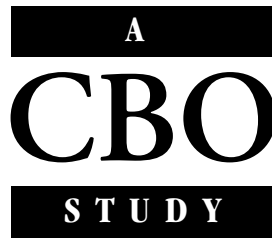
A
CBO
STUDY

MAY 2006

Options for the
Navy's Future
Fleet



Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE MAY 2006		2. REPORT TYPE		3. DATES COVERED 00-05-2006 to 00-05-2006	
4. TITLE AND SUBTITLE A CBO Study. Options for the Navy's Future Fleet				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Congressional Budget Office,Ford House Office Building, 4th Floor,Second and D Streets, SW,Washington,DC,20515-6925				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 116	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



Options for the Navy's Future Fleet

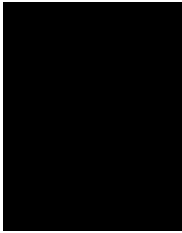
May 2006

Notes

Unless otherwise indicated, all years referred to in this study are federal fiscal years (which run from October 1 to September 30), and all dollar amounts are in 2007 dollars.

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

The cover shows (clockwise from upper right): a fast combat support ship (T-AOE-6), an artist's conception of the littoral combat ship, an amphibious assault ship (LHD-6), a Nimitz class aircraft carrier (CVN-73), an Arleigh Burke class destroyer (DDG-75), and a Los Angeles class attack submarine (SSN-760). Photos are courtesy of the U.S. Navy and General Dynamics.



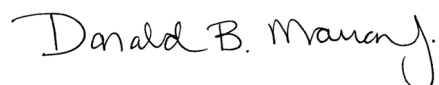
Preface

Today's Navy numbers about 285 battle force ships (a category that includes aircraft carriers, submarines, surface combat ships, amphibious warfare ships, and various support vessels). Recently, the Navy indicated that it needs a fleet of 313 ships to perform all of its missions. Building and sustaining such a force, however, would require greater budgetary resources over the next three decades than the Navy has received in recent years. The Congressional Budget Office (CBO) estimates that the Navy would have to spend an average of about \$21 billion per year (in 2007 dollars) on ship procurement to carry out its 313-ship plan—more than 70 percent greater than its average spending between 2000 and 2005. At the same time, the Navy has plans to modernize its aircraft that, if fully implemented, would require more resources than the service currently spends on new planes and helicopters.

Given the many pressures that the federal budget will face in coming decades, the Navy might not receive a sizable increase in funding. In that case, what alternative force structures could be accommodated within existing spending levels? This CBO study—prepared at the request of the Subcommittee on Seapower of the Senate Committee on Armed Services—examines that question. It looks at the Navy's modernization plans for ships and aircraft and their budgetary implications. It also analyzes five alternative approaches to modernization that would cost roughly the same average annual amount as the Navy has spent since 2000. In keeping with CBO's mandate to provide impartial analysis, this study makes no recommendations.

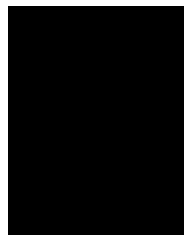
Eric J. Labs of CBO's National Security Division wrote the study under the general supervision of J. Michael Gilmore. Raymond Hall, Matthew Goldberg, David Newman, David Arthur, Bruce Arnold, Douglas Hamilton, Jo Ann Vines, and Arlene Holen of CBO provided information or comments on an earlier draft. In addition, officials and analysts from the Navy and Marine Corps, Northrop Grumman, and General Dynamics provided information for the analysis. Ronald O'Rourke of the Congressional Research Service and Robert O. Work of the Center for Strategic and Budgetary Assessments reviewed the manuscript and offered insights. (The assistance of such external participants implies no responsibility for the final product, which rests solely with CBO.)

Christian Howlett edited the study; Christine Bogusz and Loretta Lettner proofread it. Cynthia Cleveland formatted the tables, and Maureen Costantino designed the cover and prepared the study for publication. This and other CBO reports are available at the agency's Web site: www.cbo.gov.



Donald B. Marron
Acting Director

May 2006



Contents

Summary xi

1

Introduction 1

Composition and Organization of the Navy's Fleet 1

Missions of the Navy 3

Future Naval Threats 4

The Evolution of the Navy's Goals for Battle Force Ships 5

Operating Changes for Battle Force Ships 9

2

The Navy's Current Plan for Modernizing the Fleet 13

Major Weapons Programs 13

Budgetary Implications of the Navy's Plan 25

3

Lower-Cost Alternatives to the Navy's Modernization Plan 33

Option 1: Reduce Ship Programs Across the Board 36

Option 2: Emphasize the Navy's New Surface Combatants 40

Option 3: Maintain 55 Attack Submarines over the Long Term 44

Option 4: Maintain 11 Aircraft Carriers over the Long Term 49

Option 5: Deploy and Maintain a Robust Sea-Basing Capability 52

The Effect of Different Budget Assumptions on the Options 58

4

Comparing the Options by Various Measures of Capability	59
Total Number of Battle Force Ships	60
Total Number of Strike Groups	60
Total Full-Load Displacement	62
Average Ship Age	63
Total Crew Size and Direct Operation and Support Costs	65
Number of Major Combatants Providing Forward Presence	65
Number of Helicopter Hangars	65
Number of Vertical Launch System Cells	67
Covert-Mission Days Provided by Submarines	69
Targets Attacked per Day by Carrier-Based Aviation	69
Naval Surface Fire Support	70
Total Amount of Lift on Amphibious and Maritime Prepositioning Ships	72
Implications of the Analysis	78

A

Effect of the Options on the Amount of Shipbuilding Work	79
---	-----------

Tables

S-1.	The Alternative Force Structures Examined in CBO's Analysis	<i>xx</i>
S-2.	Capabilities of the Navy's Battle Force Ships in 2020 and 2035 Under Alternative Force Structures	<i>xxvi</i>
1-1.	Distribution of the Navy's Battle Force Ships, 1990 and 2006	<i>2</i>
2-1.	New Classes of Ships Scheduled to Enter the Fleet Through 2035	<i>16</i>
2-2.	The Navy's and CBO's Estimates of the Costs of Major New Ships	<i>19</i>
3-1.	The Alternative Force Structures Examined in CBO's Analysis	<i>34</i>
3-2.	Composition of the Battle Force Fleets in 2020 and 2035 Under Alternative Force Structures	<i>39</i>
3-3.	Average Annual Spending for Ships and Aircraft Under Alternative Force Structures	<i>40</i>
4-1.	Capabilities of the Navy's Battle Force Ships in 2020 and 2035 Under Alternative Force Structures	<i>76</i>
A-1.	How Budget Authority for Ship Construction Is Allocated, by Ship	<i>81</i>

Figures

S-1.	Composition of the Current and 313-Ship Battle Force Fleets	<i>xii</i>
S-2.	Inventory of Battle Force Ships Under the Navy's 2006 Shipbuilding Plan	<i>xvi</i>
S-3.	Inventory of Submarines, Cruisers, and Destroyers Under the Navy's 2006 Shipbuilding Plan	<i>xvii</i>
S-4.	Ship and Aircraft Costs Under the Navy's 2006 Shipbuilding Plan	<i>xix</i>
S-5.	Inventory of Battle Force Ships Under Alternative Force Structures	<i>xxi</i>
1-1.	Number of Ships the Navy Needs, According to Various Defense Department Analyses	<i>6</i>
2-1.	Purchases, Costs, and Inventory of Battle Force Ships Under the Navy's 2006 Shipbuilding Plan	<i>14</i>
2-2.	Inventory of Submarines, Cruisers, and Destroyers Under the Navy's 2006 Shipbuilding Plan	<i>28</i>
2-3.	Ship and Aircraft Costs Under the Navy's 2006 Shipbuilding Plan	<i>31</i>
3-1.	Purchases, Costs, and Inventory of Battle Force Ships Under Option 1	<i>37</i>

Figures (Continued)

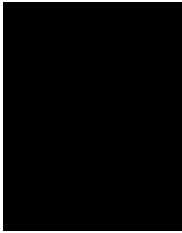
3-2.	Ship and Aircraft Costs Under Option 1	41
3-3.	Purchases, Costs, and Inventory of Battle Force Ships Under Option 2	43
3-4.	Ship and Aircraft Costs Under Option 2	44
3-5.	Number of Attack Submarines the Navy Needs, According to Various Defense Department Analyses	45
3-6.	Purchases, Costs, and Inventory of Battle Force Ships Under Option 3	47
3-7.	Ship and Aircraft Costs Under Option 3	48
3-8.	Purchases, Costs, and Inventory of Battle Force Ships Under Option 4	51
3-9.	Ship and Aircraft Costs Under Option 4	52
3-10.	Purchases, Costs, and Inventory of Battle Force Ships Under Option 5	54
3-11.	Ship and Aircraft Costs Under Option 5	55
4-1.	Number of Battle Force Ships Under Alternative Force Structures	60
4-2.	Number of Strike Groups Under Alternative Force Structures	61
4-3.	Total Full-Load Displacement of Battle Force Ships Under Alternative Force Structures	62
4-4.	Average Age of Battle Force Ships Under Alternative Force Structures	63
4-5.	Total Crew Size and Direct Operating Costs of Battle Force Ships Under Alternative Force Structures	64
4-6.	Number of Major Combatants Providing Forward Presence Under Alternative Force Structures	66
4-7.	Number of Helicopter Hangars on Surface Combatants Under Alternative Force Structures	67
4-8.	Number of VLS Cells on Surface Combatants and Attack Submarines Under Alternative Force Structures	68
4-9.	Total Covert-Mission Days Provided by the Attack Submarine Force Under Alternative Force Structures	70
4-10.	Number of Targets Attacked per Day by Carrier Aircraft Under Alternative Force Structures	71
4-11.	Amount of Gunfire Support That Could Be Surged to a Theater of Operations in Wartime Under Alternative Force Structures	73
4-12.	Amount of Magazine Capacity That Could Be Surged to a Theater of Operations in Wartime Under Alternative Force Structures	74

Figures (Continued)

4-13.	Total Lift Provided by Amphibious and Maritime Prepositioning Forces in 2020 and 2035 Under Alternative Force Structures	75
A-1.	Average Annual Amount of Lightship and Condition A Displacement Allocated to Major Shipyards Under Alternative Force Structures, 2005 to 2035	80
A-2.	Average Annual Amount of Lightship Displacement and Budget Authority, by Major Category, 2000 to 2005	82
A-3.	Lightship Displacement Allocation Index, by Major Ship Category, Under Alternative Force Structures	83
A-4.	Budget Authority Allocation Index, by Major Ship Category, Under Alternative Force Structures	84

Boxes

S-1.	The Roles of Major Types of Ships in the Navy's Fleet	<i>xiii</i>
S-2.	Classifications of Major Ships, Aircraft, and Weapons	<i>xiv</i>
2-1.	Developing Cost Estimates for Navy Ships and Aircraft	27
2-2.	The Treatment of Inflation in Estimating Future Shipbuilding Costs	29
3-1.	Creating an LPD-17 Fire-Support Ship	56



Summary

Since 2000, the Navy has spent an average of about \$43 billion a year to buy and operate its fleet of 285 battle force ships and 4,000 aircraft.¹ In the new 30-year shipbuilding plan that the Navy released in February, senior officials argue that the service needs 313 ships to perform all of the tasks assigned to it. Increasing and modernizing ships and aircraft as implied by that plan would cost an average of about \$53 billion annually over the next three decades, the Congressional Budget Office (CBO) estimates. (Those past and projected cost figures, like the others in this analysis, are in 2007 dollars.)

The Navy's need for additional resources to fund its modernization plan is likely to coincide with myriad other pressures on the federal budget—from elsewhere in the military, from Social Security and Medicare, and from the need to pay interest on federal debt, to name a few. If the Navy ends up not receiving any increases in funding other than for inflation, how big and how capable can the fleet be in future years?

To answer that question, CBO constructed five alternative approaches to modernization that would cost roughly the same average amount annually as the Navy has spent in the past six years. The first option would make across-the-board cuts to the fleet to fit within recent spending levels. The other four options would emphasize one of the following: surface combatants, submarines, aircraft

carriers, or amphibious warfare and maritime prepositioning ships.² Those options illustrate the trade-offs that the Navy might have to make if officials chose to focus their modernization efforts on one aspect of naval warfare at the expense of others.

The main conclusion of CBO's analysis is that unless shipbuilding budgets increase significantly in real (inflation-adjusted) terms or the Navy designs and builds much cheaper ships, the size of the fleet will fall substantially. In some cases, however, the fleet's capability would not decline commensurately with the decrease in size. In fact, by such measures as the number of long-range naval guns and helicopters available in peacetime or wartime and the number of targets that could be attacked each day by carrier-based aircraft, the Navy would be more capable in 2035 under one or more of the options than it is now. The Navy's more-expensive shipbuilding plan would provide greater capability than most of those options by most measures of capability. But even under the Navy's plan, the number of covert-mission days provided by submarines, the number of vertical launch system (VLS) cells for firing missiles, and the fleet's capacity to transport or store equipment for Marine Corps units would be lower in 30 years than they are today.

Composition and Organization of the Navy's Fleet

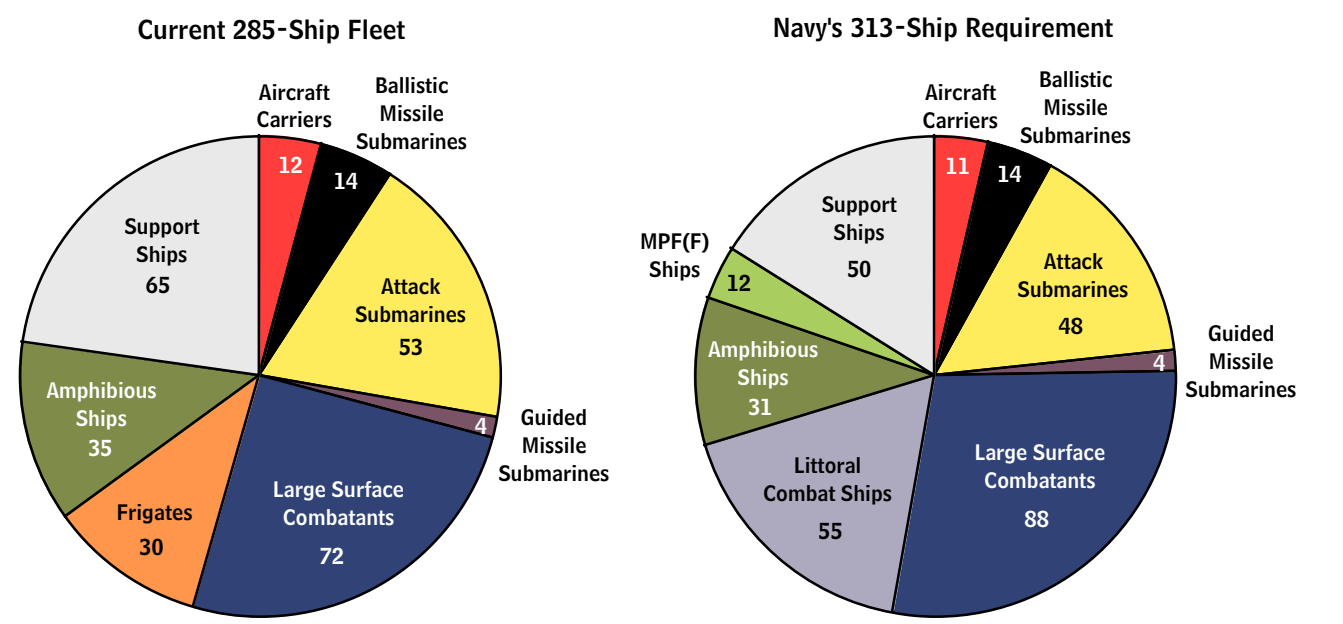
At the beginning of 2006, the battle force fleet numbered 285 combat and support ships (see Summary Figure 1). Those vessels comprise 12 aircraft carriers, 14 ballistic missile submarines, 53 nuclear-powered attack submarines, four guided missile submarines (which are con-

1. The Navy defines battle force ships as aircraft carriers, submarines, surface combatants (cruisers, destroyers, frigates, and littoral combat ships), amphibious warfare ships, combat logistics ships, and certain support vessels. For more information about specific components of the battle force fleet, see Congressional Budget Office, *The Future of the Navy's Amphibious and Maritime Prepositioning Forces* (November 2004), *Transforming the Navy's Surface Combatant Force* (March 2003), and *Increasing the Mission Capability of the Attack Submarine Force* (March 2002).

2. Maritime prepositioning ships are used to store equipment for Marine Corps units in areas near where those units might be called on to operate overseas.

Summary Figure 1.

Composition of the Current and 313-Ship Battle Force Fleets



Source: Congressional Budget Office.
Note: MPF(F) = Maritime Prepositioning Force (Future).

verted ballistic missile submarines), 102 surface combatants, 35 amphibious warfare ships, and 65 logistics, support, and mine-warfare ships. (For a brief description of the roles that those different types of ships play, see Summary Box 1.)

To provide combat capability around the globe, the Navy currently organizes its ships into 36 strike groups. Twelve are carrier strike groups, which consist of an aircraft carrier accompanied by three surface combatants, an attack submarine, and a combat logistics ship. Another 11 groups are expeditionary strike groups, which are composed of three amphibious warfare ships, three surface combatants, and one attack submarine. Nine others are surface action groups, made up entirely of surface combatants (three apiece). The four remaining strike forces each consist of a single guided missile submarine (or SSGN).³

That organizational structure, which was introduced in 2002 and 2003, represents a substantial change from the end of the Cold War. At that time, aircraft carriers were

divided into carrier battle groups with six surface combatants apiece, and amphibious ships were organized into 12 amphibious ready groups, which often operated without the support of surface combatants.

The Department of the Navy’s inventory also includes about 4,000 planes and helicopters, 900 of which belong to the Marine Corps. The overwhelming majority of those aircraft form part of the Navy’s 10 active and one reserve carrier air wings, the Marines’ three active and one reserve air wings, and the Navy’s four land-based patrol and reconnaissance wings. Each carrier air wing currently consists of 44 strike fighters, four electronic attack aircraft, four airborne early-warning planes, and 12 helicopters.

The Navy’s 2006 Shipbuilding Plan for Modernizing the Fleet

In the summer of 2005, the new Chief of Naval Operations, Admiral Michael Mullen, ordered a reexamination of the ship requirements outlined in the Navy’s previous shipbuilding plan, which had been sent to the Congress in March 2005. That plan envisioned a fleet of between 260 and 325 battle force ships. Admiral Mullen said he

3. For a list of common abbreviations and letter designations for Navy ships, aircraft, and weapons, see Summary Box 2.

Summary Box 1.**The Roles of Major Types of Ships in the Navy's Fleet**

Nimitz Class
Aircraft Carrier

The Navy's 12 **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. Nine of the 12 current carriers belong to the Nimitz class.



Ohio Class Ballistic
Missile Submarine

Strategic **ballistic missile submarines** carry the major portion 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 is converting four more to a conventional guided missile (SSGN) configuration. Those SSGNs will be able to 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 cruise missiles at inland targets in the early stages of conflicts. The Navy has 53 attack submarines, of which 49 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

Surface combatants—which include cruisers, destroyers, and frigates—are the workhorses of the fleet. They defend the Navy's aircraft carriers and amphibious ships against other surface ships, aircraft, and submarines. They also perform many day-to-day missions, such as patrolling sea lanes, providing 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 4,000 to 10,000 tons.



Wasp Class Amphibious
Assault Ship

The Navy's two classes of **amphibious assault ships** (also known as helicopter carriers) are the second largest ships in the fleet at 40,000 tons. They form the centerpiece of expeditionary strike groups and can each carry about half the troops and equipment of a Marine expeditionary unit. They also carry as many as 30 helicopters and six 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, 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 expeditionary strike group.



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.



Avenger Class Mine
Countermeasures Ship

The Navy has two types of **mine-clearing ships**: Avenger class mine countermeasures ships and Osprey class coastal mine hunters. They are very small vessels (around 1,000 tons) built to clear mines from U.S. or overseas waters.

Source: Congressional Budget Office.

Note: Ship silhouettes are not to scale.

Summary Box 2.

Classifications of Major Ships, Aircraft, and Weapons

AGOS	ocean-surveillance ship	LHD	amphibious assault ship (helicopter carrier)
AGS	Advanced Gun System	LPD	amphibious transport dock
AKE	dry cargo/ammunition ship	LSD	dock landing ship
AO	fleet oiler	LSD(X)	future dock landing ship
AOE	fast combat support ship	MCM	mine countermeasures ship
ARS	rescue and salvage ship	MHC	mine hunter, coastal
CG	guided missile cruiser	MMA	Multimission Maritime Aircraft
CG(X)	future guided missile cruiser	MPF(F)	Maritime Prepositioning Force (Future)
CLF	Combat Logistics Force	MPS	maritime prepositioning squadron
CV	aircraft carrier	SSBN	ballistic missile submarine
CVN	nuclear-powered aircraft carrier	SSBN(X)	future ballistic missile submarine
DD	destroyer	SSGN	guided missile submarine
DDG	guided missile destroyer	SSN	attack submarine
DDG(X)	future guided missile destroyer	STOVL	short takeoff and vertical landing
ERM	Extended Range Munition	T-_____	ship operated by the Military Sealift Command
FFG	guided missile frigate	UCAV	unmanned combat air vehicle
JSF	Joint Strike Fighter	VLS	vertical launch system
LCS	littoral combat ship		
LHA	amphibious assault ship (helicopter carrier)		

Source: Congressional Budget Office.

ordered the review for two reasons: to arrive at a single numerical requirement for the fleet, and to provide stability in the year-to-year construction of naval vessels so that both the Navy and the shipbuilding industry could plan more efficiently.

In February 2006, the Navy formally submitted its new 30-year plan to the Congress, which includes a requirement for 313 battle force ships.⁴ That requirement would be permanent, although the actual number of ships would rise and fall depending on when vessels were retired from the fleet and on what budgetary resources were available for buying new ships.⁵ The 2006 shipbuilding plan calls for the following fleet by 2020:

- 11 aircraft carriers (including a new CVN-21 class of nuclear-powered carriers);
- 14 strategic ballistic missile submarines;
- 48 attack submarines;
- 4 guided missile submarines;
- 62 Arleigh Burke class guided missile destroyers;
- 7 future DD(X) destroyers (since named DDG-1000 Zumwalt class destroyers);
- 19 future CG(X) cruisers;
- 55 new Freedom class littoral combat ships (LCSs);
- 31 amphibious ships;
- 1 future maritime prepositioning, or MPF(F), squadron with 12 ships capable of supporting the Navy's and Marine Corps's new sea-basing concept (described below); and
- 50 support ships.

4. Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY 2007* (February 2006). For a detailed discussion of that plan, see Geoff Fein, "Navy Sustains Carrier Requirement Under \$13.4 Billion Plan," *Defense Daily* (December 14, 2005).

5. Christopher P. Cavas, "U.S. Ship Plan to Cost 20 Percent More: Price Control Will Be Key to Funding 313-Vessel Fleet," *Defense News* (December 5, 2005).

That fleet would be organized around 11 carrier strike groups (one less than exists now), nine expeditionary strike groups (two less than in the current fleet), nine surface action groups, and four SSGN strike forces.

In addition to that broad outline, more details about the Navy's procurement plans over the next five years come from the 2006 defense appropriation and authorization laws and from the Future Years Defense Program that was prepared as part of the President's 2007 budget request. According to those sources, the Navy proposes to buy 51 ships between 2007 and 2011—one aircraft carrier, five submarines, six large surface combatants, 23 small surface combatants, 11 amphibious and maritime prepositioning ships, and five support ships. During the same period, it would retire one aircraft carrier, one small surface combatant, eight amphibious ships, 13 support ships, and two minesweeping ships. The Navy also proposes to purchase about 1,200 aircraft during the 2007-2011 period.

Under the 2006 shipbuilding plan, the Navy would buy another 218 ships between 2012 and 2035. Those vessels comprise six aircraft carriers, 44 attack submarines, 14 strategic ballistic missile submarines, 45 large surface combatants, 49 small surface combatants, 21 amphibious and maritime prepositioning ships, and 39 support ships.

With respect to aircraft, CBO assumes that the Navy would procure about 2,600 planes and helicopters between 2012 and 2035.⁶ The Navy's plan calls for continuing to have 10 active, deployable carrier air wings. The reserve wing does not deploy with a carrier, but its pilots and planes would train so that they could augment the deployable air wings as necessary.

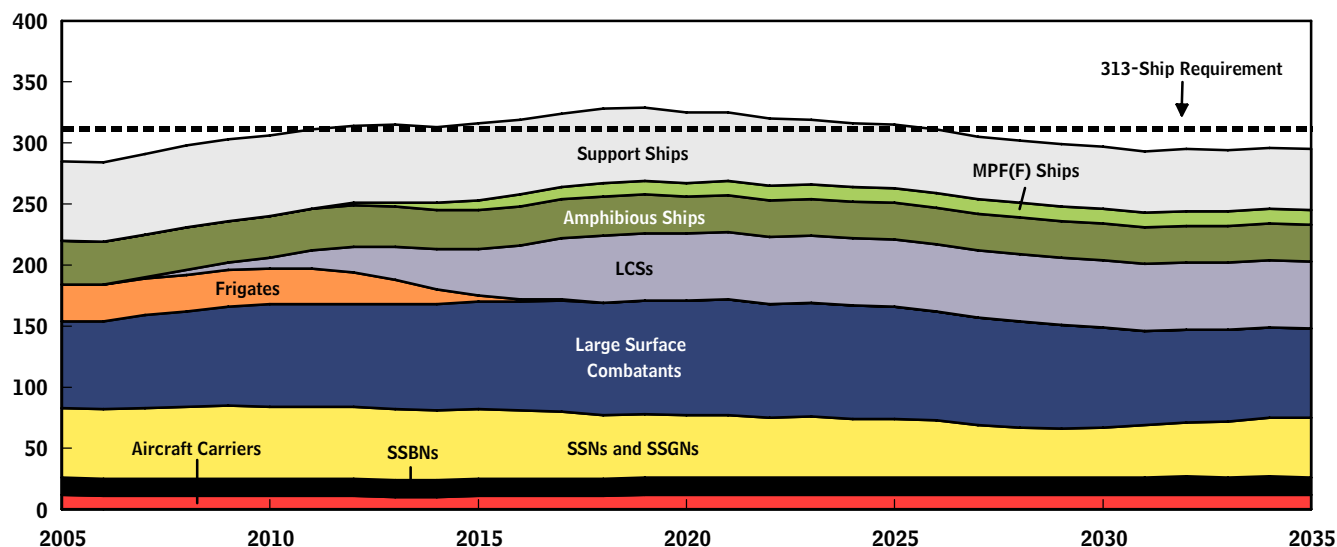
Budgetary Implications of the Navy's Plan

Buying and operating all of the ships listed in the 2006 shipbuilding plan and all of the aircraft implied by that plan would cost an average of about \$53 billion a year for the next three decades, CBO estimates. That amount is 23 percent higher than the Navy's average annual

6. Estimated procurement of aircraft between 2012 and 2024 is based on Congressional Budget Office, *The Long-Term Implications of Current Defense Plans and Alternatives: Summary Update for Fiscal Year 2006* (October 2005). Beyond 2024, CBO assumed that as old aircraft reached the end of their service life, they would be replaced with new models on a one-for-one basis.

Summary Figure 2.

Inventory of Battle Force Ships Under the Navy's 2006 Shipbuilding Plan



Source: Congressional Budget Office.

Note: SSBNs = ballistic missile submarines; SSNs = attack submarines; SSGNs = guided missile submarines; LCSs = littoral combat ships; MPF(F) = Maritime Prepositioning Force (Future).

spending on ships and aircraft between 2000 and 2005. Even such an increase, however, would be insufficient to keep the battle force fleet at the Navy's goal of 313 ships indefinitely.

Ship Procurement

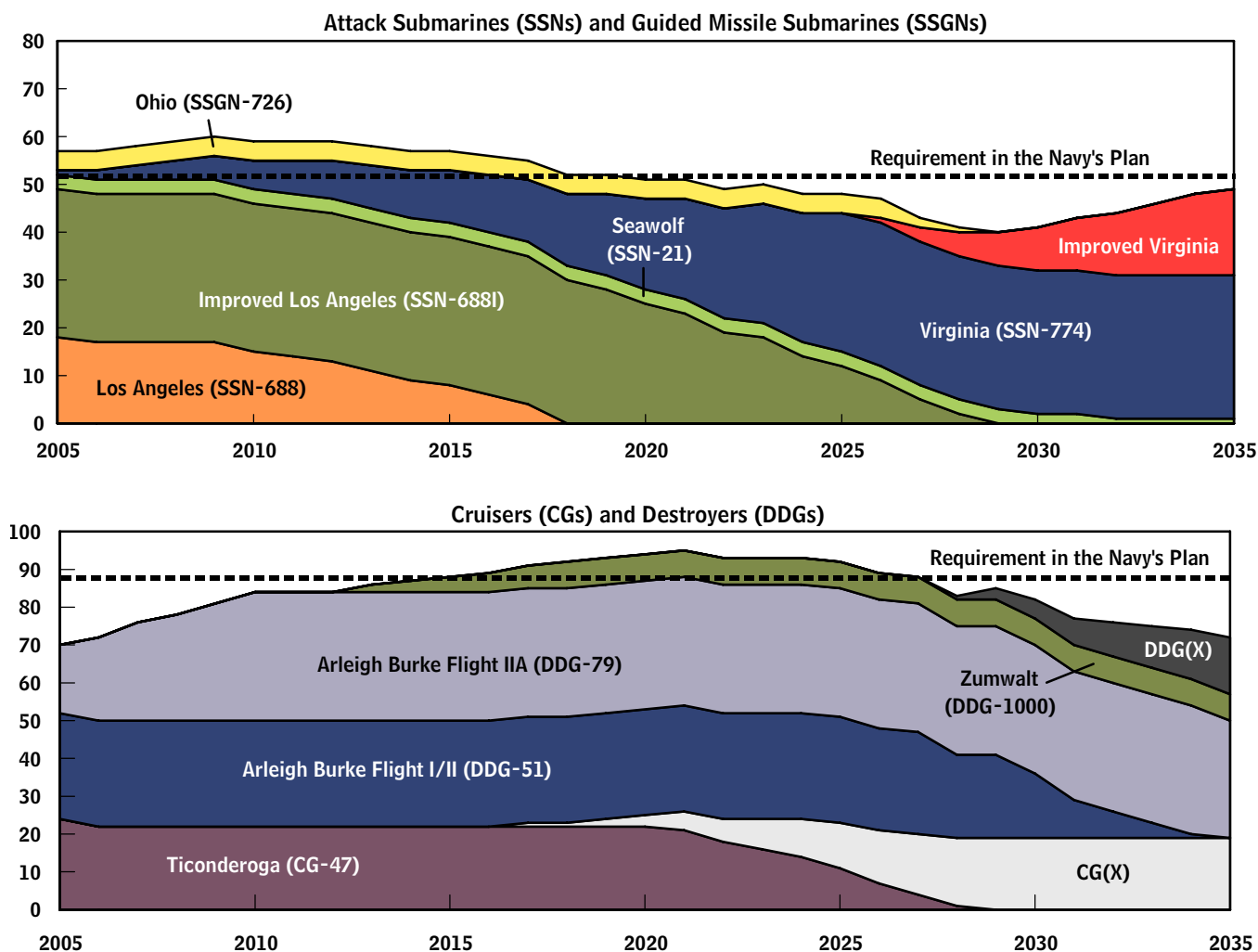
To execute its ship construction plan, the Navy would buy a total of 275 ships over the 2006-2035 period—an average of 9.2 per year. The Navy estimates that procuring those new ships would cost about \$14.4 billion a year, whereas CBO estimates that they would cost an average of about \$19.5 billion annually.⁷ With other ship construction costs that the Navy would face over that period included, the average annual shipbuilding budget would need to rise to \$21.6 billion, CBO estimates. (Those

additional costs include refueling nuclear-powered aircraft carriers and submarines, buying mission modules for littoral combat ships, and modernizing current large cruisers and destroyers.)⁸

The size of the battle force fleet would initially rise under the Navy's plan as the 55 new littoral combat ships entered the inventory over the next 20 years. The fleet would peak at 330 ships in 2019 but then gradually decline to 294 by 2035—19 less than the 313-ship requirement (see Summary Figure 2). In fact, if the construction rates for various types of ships envisioned in the Navy's plan continued indefinitely, the fleet would not be close to 313 ships at any point after 2025.

7. CBO's figure is larger for two reasons. First, CBO's cost estimates for new classes of ships, which are based on the prices of past ships and on relationships between a ship's weight and its cost, are generally higher than the Navy's estimates or cost targets. Second, CBO assumes that annual price increases for the labor and materials used in shipbuilding will continue to outstrip inflation for other defense procurement programs (as they have for the past 15 years) until the early 2020s.

8. The new littoral combat ship that is being designed to operate in coastal waters is expected to have a modular payload system. Under that system, different pieces of equipment for performing a particular mission would be grouped together as a "module" or "mission package" and sent out with the ship when it deployed. The Navy is planning to buy those modules under its "other procurement, Navy" account rather than under one of its shipbuilding accounts. If that equipment was a permanent part of the ship, as on a large destroyer or cruiser, it would be purchased under the shipbuilding account.

Summary Figure 3.**Inventory of Submarines, Cruisers, and Destroyers Under the Navy's 2006 Shipbuilding Plan**

Source: Congressional Budget Office.

Two categories of ships—submarines and large surface combatants—are responsible for most of the shortfall under that plan. The Navy intends to increase its construction of attack submarines to two per year in 2012 and maintain that rate through 2028, at which point it would shift to building two submarines every even year and one every odd year. At that rate of construction, the force of attack and guided missile submarines would fall below the 52-ship goal starting in 2020 (see Summary Figure 3). The four guided missile submarines in the current fleet, which are part of the 313-ship requirement, would not be replaced under the Navy's plan when they reached the end of their service life in the late 2020s.

Similarly, the ship construction schedule for large surface combatants in the Navy's plan would not keep the cruiser and destroyer force at the desired size of 88. After purchasing seven DDG-1000 Zumwalt destroyers and 19 CG(X) cruisers, that schedule envisions starting to replace today's Arleigh Burke class destroyers in 2023 at a rate of two per year. As a result, the cruiser and destroyer force would begin to fall below the 88-ship requirement in 2028, declining to 73 by 2035. If the construction rate of two large surface combatants per year was maintained indefinitely, the cruiser and destroyer force would continue to shrink until 2045 (to 61 ships) before starting to grow again.

Procurement and Operating Costs for Ships and Aircraft

Besides ship procurement costs, which are the focus of this study, CBO estimated the amount of funding that the Navy would need to carry out its aircraft programs and to operate its planned fleets of ships and aircraft. The alternative modernization plans that CBO constructed for this analysis assume that if the Navy can save money in any of those areas, it will use the savings to pay for ship construction.

Direct operation and support (O&S) costs for battle force ships currently total about \$14 billion per year.⁹ Under the 2006 shipbuilding plan, annual direct O&S costs would decline to \$13.1 billion by 2035. That reduction would occur because, over time, ships that were less expensive to operate would replace ships with higher operating costs. For example, the littoral combat ship, which would be introduced in large numbers under the Navy's plan, is likely to be cheaper to operate than other, larger classes of ships whose numbers would be cut under the plan, such as amphibious ships or submarines. In addition, new classes of ship such as the Zumwalt class destroyer, CG(X) cruiser, and CVN-21 aircraft carrier are intended to have smaller crew sizes, and thus lower operating costs, than their predecessors. Over the entire 2006-2035 period, direct O&S costs for the battle force fleet would average \$14.3 billion per year.

Procuring the aircraft under the Navy's 2006 plan would cost about \$7.5 billion annually, on average, over the next 30 years.¹⁰ In addition, operating and maintaining naval aircraft would cost an average of about \$9.2 billion a year, CBO estimates.

In sum, under the Navy's plan, total procurement and direct O&S costs for ships and aircraft would average about \$53 billion per year between 2006 and 2035, CBO estimates. By comparison, the Navy spent an average of about \$43 billion annually on such procurement, operations, and support over the past six years (see Summary Figure 4).

9. Direct operation and support costs are those directly related to the number of ships or aircraft in the fleet, such as costs for fuel, supplies, and compensation of personnel. CBO estimated those costs using information from the Navy's Visibility and Management of Operating and Support Costs (or VAMOSOC) database.

10. That procurement figure excludes several of the Navy's cost categories: modifications of aircraft, spares and repair parts, and aircraft support equipment and facilities.

Options for Structuring the Future Fleet Within Recent Funding Levels

If the Navy does not receive or cannot devote more budgetary resources to ship construction in the future, to what extent can it modernize its fleet? To address that question, CBO looked at five different ways in which the Navy could keep its total ship and aircraft procurement and O&S costs at an average of about \$43 billion annually over the next 30 years (see Summary Table 1). The first option would continue to cut the various components of the battle force fleet by roughly equal percentages—as the Navy has done since the end of the Cold War. The other four alternatives would emphasize a specific area of naval warfare at the expense of others. Option 2 would focus on introducing the new, more capable classes of surface combatants that the Navy wants. Options 3 and 4 would make a priority of meeting the Navy's stated requirements for submarines or aircraft carriers over the long term. Option 5 would focus on introducing ships that would help the Navy support and supply onshore Marine operations entirely from the sea rather than from the land (a concept known as sea basing). CBO chose those alternatives to illustrate the potential consequences for different parts of the fleet if large and sustained increases in funding for ship construction do not occur.

CBO found no option that could do more with less. Saving money on the battle force fleet relative to the Navy's plan requires buying fewer ships and thus having less capability than under that plan (although a few types of capability would still be greater than exists today). Unless the Navy can provide the level of resources necessary to implement the 2006 shipbuilding plan, it will have to make different choices about how to structure its forces in the future.

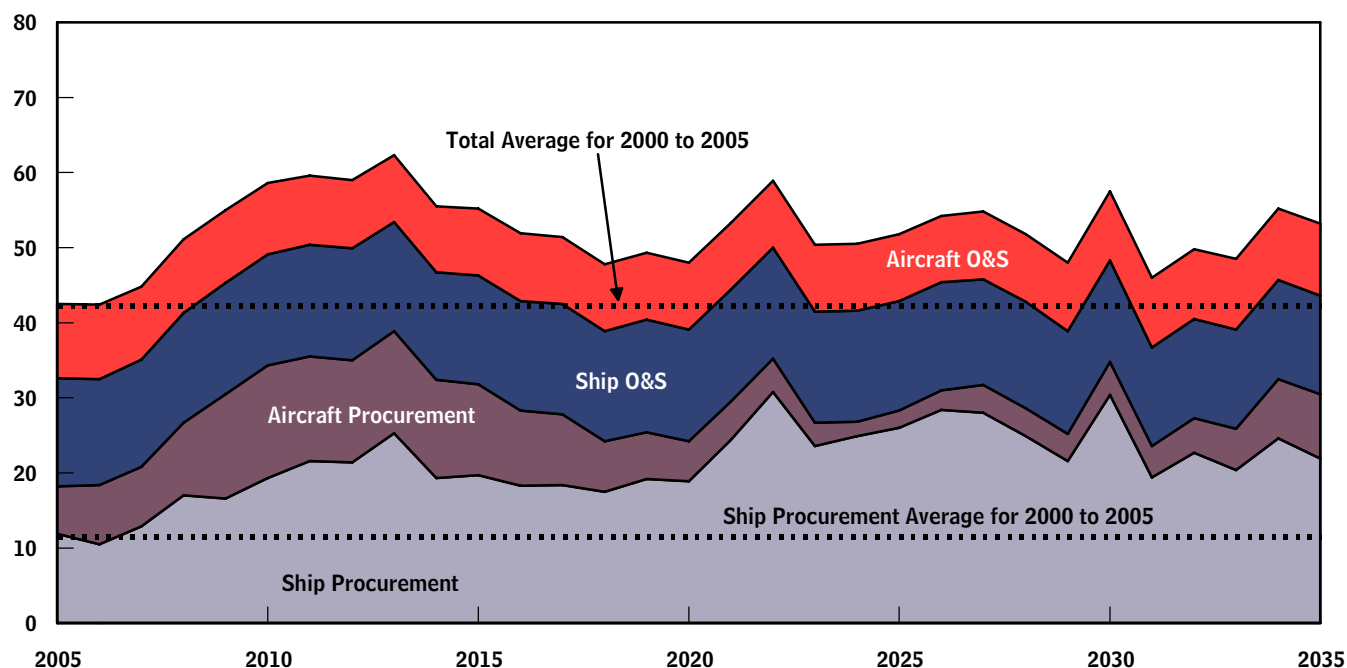
Option 1: Reduce Ship Programs Across the Board

The first alternative would trim all of the major components of the fleet by about 30 percent to 40 percent from the numbers in the 313-ship requirement. It would not cancel any new class of ship and would buy all of the new weapons and technologies that Navy leaders have said are essential to the future force. To the extent that the Navy views the 313-ship fleet as "transformational," this option would follow the same path of transformation but on a smaller scale.

The recent history of reductions in naval forces is consistent with cuts spread in roughly equal proportion across

Summary Figure 4.**Ship and Aircraft Costs Under the Navy's 2006 Shipbuilding Plan**

(Billions of 2007 dollars)



Source: Congressional Budget Office.

Notes: O&S = direct operation and support costs (those directly related to the number of ships or aircraft in the fleet, such as costs for fuel, supplies, and compensation of personnel).

Procurement costs for 2006 exclude supplemental funding related to Hurricane Katrina.

the fleet. Since 1990, the size of the battle force fleet has dropped by half (from 574 ships to 285). But the composition of the fleet has remained relatively constant, with no category of ship varying by more than 3 percentage points in its contribution to the total fleet.

Under this option, the number of aircraft carriers, and thus the number of carrier strike groups, would be reduced to seven from the 11 in the Navy's plan. Current Nimitz class carriers would not be retired early; instead, the program to build the new CVN-21 carrier would be delayed from 2008 to the 2020s.¹¹

The number of expeditionary strike groups would also decline to seven (from nine), and the number of amphibious ships in those strike groups would be cut in half. However, this option would buy one MPF(F) squadron,

and CBO assumed that its new ships, which would have strong sea-basing capabilities, would probably operate with expeditionary strike groups to some degree once they were stationed overseas.

Submarine forces would be reduced by about one-third from the Navy's planned levels. The number of ballistic missile submarines would decline from 14 to 10 and the number of attack submarines would fall from the planned 48 to 35.

With respect to surface combatants, the force of Arleigh Burke class destroyers would be cut by nearly 40 percent, meaning that they would not need to be replaced until 2026. Total purchases of Zumwalt class destroyers, CG(X) cruisers, and littoral combat ships would be about 30 percent smaller than in the Navy's plan.

11. In such cases, the options include resources to sustain the carrier industrial base during the years when Nimitz class carriers were being refueled but no new carriers were being built.

Under this alternative, the total number of battle force ships would increase from 285 today to 299 in 2020 and then decline to 217 by 2035 (see Summary Figure 5).

Summary Table 1.

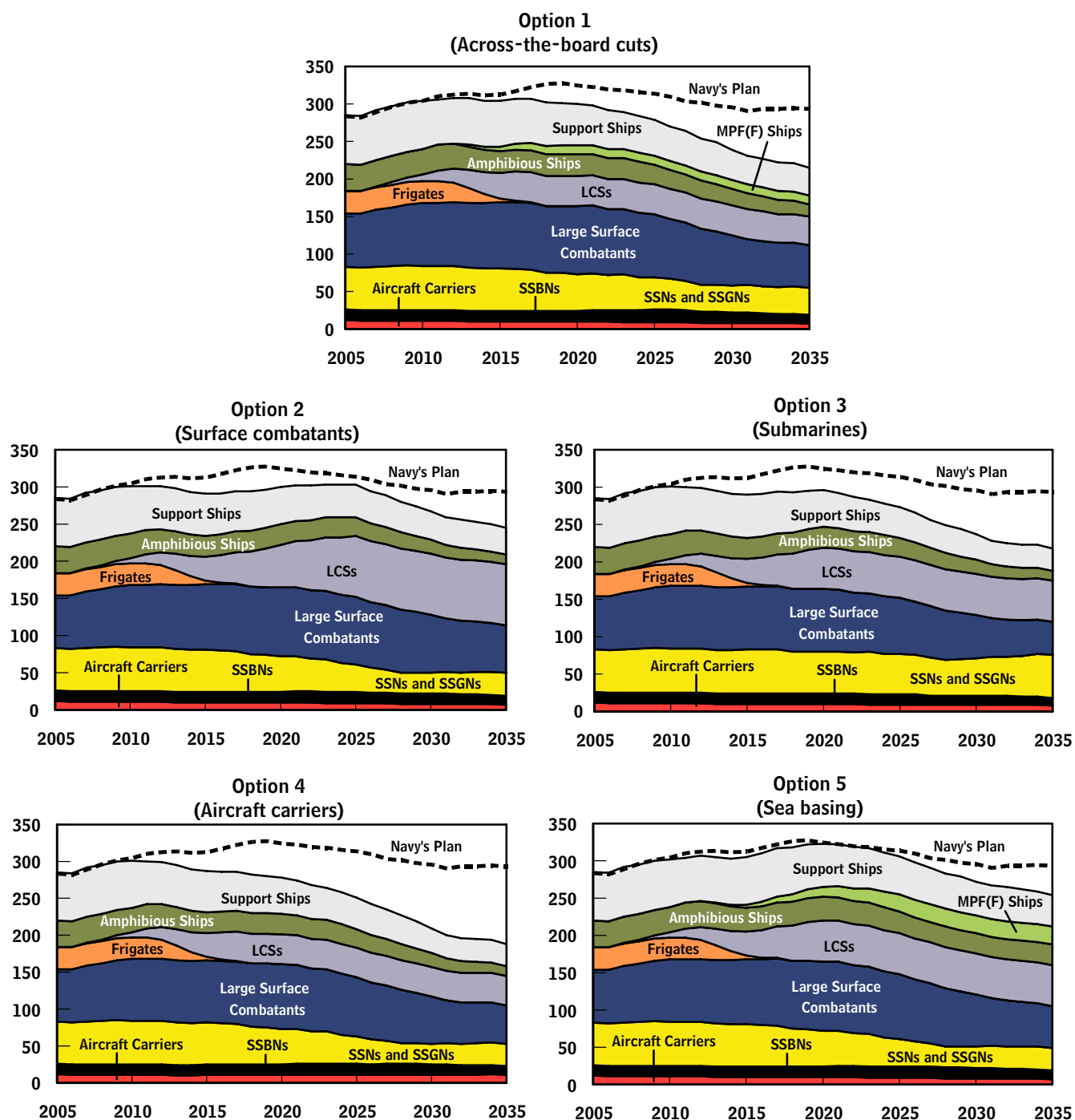
The Alternative Force Structures Examined in CBO's Analysis

						Memorandum:	
						Current Fleet ^a	Navy's 313-Ship Requirement
Option 1	Option 2	Option 3	Option 4	Option 5			
For an Equal Amount of Annual Funding (\$43 billion in 2007 dollars ^b), the Navy Could Have One of the Following:							
	The same mix of capabilities as currently planned but fewer ships	The new types of destroyers, cruisers, and littoral combat ships now planned	55 attack submarines over the long term	11 aircraft carriers and 10 air wings over the long term	A robust capability to support onshore operations from the sea (sea basing)	n.a.	c
With These Ships over the Long Term: ^d							
Aircraft Carriers	7	7	8	11	7	12	11
Surface Combatants							
DDG-51s/DDG(X)s	38	28	31	38	38	49	62
DDG-1000s	5	7	0	0	0	0	7
CGs/CG(X)s	11	19	0	8	0	23	19
FFGs	0	0	0	0	0	30	0
LCSs	40	82	55	40	55	0	55
LPD-17 fire-support ships	0	0	0	0	7	n.a.	n.a.
Submarines							
SSNs	35	30	55	30	30	53	48
SSBNs	10	10	10	10	10	14	14
SSGNs	0	0	4	0	0	4	4
Amphibious Ships	15	13	13	13	28	35	31
MPF(F) Ships (Squadrons)	12 (1)	0	0	0	24 (2)	0	12 (1)
Logistics and Support Ships	38	37	31	31	42	65	50
Total	211	233	207	181	241	285	313

Source: Congressional Budget Office.

Note: n.a. = not applicable; DDG-51 = Arleigh Burke class destroyer; DDG(X) = future replacement for Arleigh Burke class destroyers; DDG-1000 = Zumwalt class destroyer (formerly the DD(X)); CG = guided missile cruiser; CG(X) = future guided missile cruiser; FFG = guided missile frigate; LCS = littoral combat ship; LPD-17 = San Antonio class amphibious transport dock; SSN = attack submarine; SSBN = ballistic missile submarine; SSGN = guided missile submarine; MPF(F) = Maritime Prepositioning Force (Future).

- At the beginning of 2006.
- \$43 billion is the average yearly amount that the Navy spent on procurement and operations and support for ships and aircraft between 2000 and 2005.
- The Navy's shipbuilding plan would require average annual funding of about \$53 billion over the next 30 years, CBO estimates.
- These numbers represent the steady-state battle force fleet—the fleet that could be sustained in the long term (beyond 2035) if the funding level and procurement approaches of the various options were continued indefinitely.

Summary Figure 5.**Inventory of Battle Force Ships Under Alternative Force Structures**

Option 2: Emphasize the Navy's New Surface Combatants

The second approach to modernizing the Navy within recent funding levels would be to buy all three of the service's new types of surface combatants but fewer of its other planned ships. This option would purchase the same number of Zumwalt class destroyers and CG(X) cruisers as in the Navy's 2006 plan—seven and 19, respectively—as well as 82 littoral combat ships rather than the planned 55. CBO chose the larger LCS number to highlight the belief of some Navy officials (such as the former Chief of Naval Operations, Admiral Vern Clark) that large numbers of those small, fast warships will be necessary to counter the naval threats that are likely to emerge over the next few decades.

To pay for the new surface combatants, this option would reduce the number of aircraft carriers, attack submarines, and amphibious ships substantially. As was the case in Option 1, the carrier force would be cut to seven by curtailing and postponing procurement of the new CVN-21 class. Only two of the new carriers would be bought between 2006 and 2035, the first not until 2026. The attack submarine force would decline by nearly 40 percent to 30 submarines. The amphibious force would be reduced by more than half, and the number of expeditionary strike groups would decrease by one-third (to six) compared with the Navy's plan.

Unlike the previous option, this alternative would not purchase any sea-basing ships. Instead, it would maintain two of the existing maritime prepositioning squadrons that, together, store enough equipment for two Marine brigades.

The number of Arleigh Burke destroyers and their replacements would drop from the planned 62 to just 28. However, that size force would be sufficient to provide three escorts for each carrier strike group and expeditionary strike group, assuming that the destroyers were operated using multiple crews that rotated to a ship while it was still overseas so the ship could spend more time providing forward presence in its area of operations before it had to return to its home port. (Today, by contrast, most surface combatants deploy and then return home with the same crew, which allows them to spend less time on-station in their operating area.)

The total number of battle force ships would rise to 300 in 2020 under this option. By 2035, however, the fleet

would number 246 ships, 14 percent less than the current force.

Option 3: Maintain 55 Attack Submarines over the Long Term

In the past few years, the future size of the attack submarine force has become a major issue in naval force planning. The Navy currently has 57 attack submarines (including four SSGNs, former ballistic missile submarines that were converted to a conventional configuration). However, since 1991, the Navy has been buying new attack submarines at an average rate of less than one per year, which in the long run would result in a force of only about 30 submarines. Many observers believe that the Navy will need far more attack submarines than that, particularly if China emerges as a strong enough military power to rival the United States in coming decades.

Studies by the Department of Defense and the Navy have reached widely differing conclusions over the years about how many attack submarines the Navy needs. A 1999 analysis conducted by the Joint Staff for the Chairman of the Joint Chiefs of Staff stated that between 68 and 76 submarines were necessary to perform peacetime missions, whereas 55 were sufficient to meet wartime needs. In 2003, the Navy released a plan to build a 375-ship fleet, including 55 attack submarines. Two years later, the Navy stated that its future fleet would need between 41 and 45 attack submarines, including four guided missile submarines. Most recently, the 313-ship requirement includes 48 attack submarines and four SSGNs.

In light of that history, Option 3 would build attack submarines at a rate that would eventually result in a force of 55—the number that the Joint Staff deemed capable of meeting the Navy's requirements for wartime. The force would be smaller than 55 submarines throughout the 2020s, however, because otherwise the Navy would need to purchase three submarines per year in 14 of the next 30 years. Such a procurement rate would be virtually impossible within the resource constraints of this analysis, given the other demands on the Navy's shipbuilding budget.

Even so, to maintain a force of 55 attack submarines without a real increase in total average funding, the Navy would have to delay or cancel most other major planned ship programs. The carrier force would be reduced to eight, with three CVN-21s purchased over the next 30 years. The Zumwalt and CG(X) programs would be can-

celed, and the number of large surface combatants (only Arleigh Burke class destroyers and their replacements) would be halved to 31. As in the surface combatant alternative (Option 2), the number of amphibious ships would be reduced to 13, and the sea-basing-capable MPF(F) program would be eliminated.

The savings from those reductions would be used to purchase the Navy's new Virginia class of nuclear-powered attack submarines and replacements for the current Ohio class SSGNs. Because those four SSGNs are conversions of existing ballistic missile submarines, they will reach the end of their service life in the late 2020s. (If the SSGNs were considered not worth replacing but the money was still devoted to submarines, the Navy could buy approximately six more Virginias, bringing the total number of attack submarines to 61.)

This option would increase the size of the Navy from 285 battle force ships to 296 by 2020. Fifteen years later, however, the fleet would number 219 ships—almost the same as with the across-the-board cuts of Option 1.

Option 4: Maintain 11 Aircraft Carriers over the Long Term

The number of aircraft carriers that the Navy needs has also been a contentious issue over the past two years. Last year, when the Navy proposed reducing the carrier force from 12 to 11 as part of the President's budget request for 2006, the Congress responded with legislation requiring the service to keep 12 operational aircraft carriers in its fleet. Nevertheless, the 2006 shipbuilding plan released in February set the Navy's requirement for carriers at 11, and the Chief of Naval Operations explicitly endorsed that number in public statements.¹² Recently, the Senate indicated that it would accede to the Navy's request to reduce the fleet to 11 carriers, but the House chose to preserve the 12-ship requirement for the time being.

Consistent with the Navy's requirement, this alternative would maintain a carrier force of at least 11 ships—three or four more than in the other options in this analysis. As a result, the Navy would buy six CVN-21s between 2006 and 2035, one every five years.

To pay for keeping 11 aircraft carriers and 10 deployable air wings without a real increase in funding, this option would reduce or eliminate all other ship construction programs. The Zumwalt class destroyer would be canceled, the CG(X) program pared from 19 to eight ships (which would be purchased to provide missile defense for carrier strike groups), and the LCS program cut from 55 to 40 ships. The number of large surface combatants would decline to 38 ships, meaning that replacements for current destroyers would not be needed until 2021. The attack submarine force would decrease by nearly 40 percent to 30 submarines, and the amphibious force would drop by more than half to just 13 ships. Like Options 2 and 3, this alternative would not introduce sea-basing capability to the maritime prepositioning force.

Overall, this approach would produce the smallest battle force fleet of the alternatives in this study: 278 ships by 2020 and 189 by 2035.

Option 5: Deploy and Maintain a Robust Sea-Basing Capability

Four years ago, the Navy released a set of guiding principles, called Sea Power 21, for transforming the service. One of those principles is sea basing, under which the Navy and Marine Corps would reduce as much as possible the need for support from land facilities when conducting a military operation overseas. Today, when large numbers of marines operate on shore, they are supported mainly from supply depots on land (located either at a base provided by a host nation or in an area seized during an assault). Sea basing envisions that future operations will forgo putting large amounts of supplies, fuel, and ammunition on shore and instead keep them at sea, re-arming and replenishing Marine forces as needed. Although the Navy's entire fleet would play a role in the sea base, the most important platforms would be amphibious warfare and future maritime prepositioning ships.

Many of the operations the Navy performs today could be characterized as sea basing on a small scale. But the Navy and Marine Corps hope that MPF(F) ships will give them the ability to conduct a brigade-sized operation ashore without support from land facilities. All logistical support for the marines, for at least the first 20 days, would be provided by ships at sea.

Under the 2006 shipbuilding plan, the Navy intends to buy one MPF(F) squadron capable of deploying and sup-

12. Dave Ahern, "Mullen: Four Ships Too Few; Stable Ship Funds Needed," *Defense Today* (October 13, 2005).

porting a Marine expeditionary brigade. The Marine Corps, however, has said that it needs to have at least two MPF(F) squadrons deployed overseas so they can be in a position to respond quickly if a crisis arises in the Middle East, southern Africa, or East Asia. This option, therefore, would buy two sea-basing-capable MPF(F) squadrons. It would also maintain nine expeditionary strike groups to ensure sufficient support from traditional amphibious ships in any expeditionary operation.

Like Options 1 and 2, this alternative would reduce the carrier force to seven and buy only two CVN-21s between 2006 and 2035. Both the Zumwalt destroyer and CG(X) cruiser programs would be canceled to save money, and the number of Arleigh Burke class destroyers (and their eventual replacements) would be cut to 38 ships. The attack submarine force would be reduced to 30.

Because this option emphasizes operations on and close to shore, it would buy 55 littoral combat ships, the same number as in the Navy's plan. It would also design and purchase seven of a new type of ship to provide the fire-support capability of the canceled Zumwalt destroyer. The new vessel—referred to here as an LPD-17 fire-support ship—would consist of a San Antonio class amphibious transport dock fitted with two Advanced Gun Systems (with a total magazine of 900 shells) and 16 VLS cells for launching missiles. In addition, this option would preserve the largest number of amphibious ships, 28, as well as 24 sea-basing ships composing the two MPF(F) squadrons.

Overall, this option would expand the Navy's battle force fleet from 285 ships today to 323 by 2020. Thereafter, the fleet would decline to 255 ships by 2035—the largest number among the five options that CBO examined.

Comparing the Capability of the Options

To illustrate the effects of those different approaches on the size and capability of U.S. naval forces, CBO used a variety of measures to compare the options with both the Navy's shipbuilding plan and the current fleet (see Summary Table 2 on page xxvi). Some of the measures relate to characteristics of the battle force fleet. They include the total number, weight (full-load displacement), crew size, and O&S costs of battle force ships, as well as their

average age and the total number of strike groups in the fleet. Other measures focus on the fleet's capability in peacetime or during a conflict:

- The amount of overseas presence provided by major combatants;
- The number of helicopters available to detect and target such threats as quiet diesel-electric submarines, mines, and small, fast boats armed with torpedoes or cruise missiles (measured by the number of helicopter hangars available on surface combatants during routine peacetime deployments or a wartime "surge" of ships);
- The number of VLS cells available on surface combatants and attack submarines in peacetime or wartime to launch land-attack missiles;
- The number of covert-mission days provided by attack submarines and SSGNs;
- The number of targets that can be attacked per day by carrier aircraft; and
- The amount of fire support (number of guns and initial magazine capacity) that the guns on battle force ships can provide at various ranges.

The final measure that CBO used to compare the options is the mobility provided by the fleet: the total transport and storage capacity of its amphibious and maritime prepositioning ships.

Of the approaches analyzed in this study, the Navy's 2006 shipbuilding plan would provide the greatest capability by 2020 and 2035 according to most measures—but at the greatest cost. The less expensive alternatives that CBO examined offer less overall capability than that plan and, in many cases, than today's fleet. However, by a few measures—such as the number of helicopter hangars that are on-station in peacetime or that can be surged in a crisis and the amount of fire support at ranges of more than 13 nautical miles—all five options would provide more capability than the Navy has now. And by some measures—the number of helicopter hangars, number of covert-mission days provided by submarines, and number of targets per day for carrier aircraft—at least one of the options would offer as much or more capability than the Navy's costlier plan.

With its across-the-board cuts, Option 1 would result in a relatively small fleet of just over 200 ships. However, it would produce the most balanced fleet of the alternatives that CBO examined while providing some of the new capabilities that the Navy seeks. The fleets in the other four options would be less balanced but might be better matched to various future threats. Those options illustrate the potential consequences of pursuing one type of capability at the expense of all others in a constrained fiscal environment.

Of those options, the surface combatant alternative (Option 2) would result in the lightest fleet but the one with the most helicopter hangars and VLS cells. The submarine alternative (Option 3) would have the lowest direct operating costs, produce the youngest fleet, and provide the most covert-mission days (more than now or under the Navy's plan). The aircraft carrier alternative (Option 4) would result in the smallest fleet but the most carrier targets per day (the same as under the Navy's plan and more than today). The sea-basing alternative (Option 5) would produce the largest and heaviest fleet, the most transport capacity, and the most surface fire support.

Summary Table 2.

Capabilities of the Navy's Battle Force Ships in 2020 and 2035 Under Alternative Force Structures

	Option 1 (Across-the- board cuts)	Option 2 (Surface combatants)	Option 3 (Submarines)	Option 4 (Aircraft carriers)	Option 5 (Sea basing)	Memorandum: Current Fleet ^a	Navy's 2006 Shipbuilding Plan
Capabilities in 2020							
Number of Battle Force Ships	299	300	296	278	323	285	326
Number of Strike Groups	34	35	32	34	35	36	35
Total Full-Load Displacement ^b (Millions of long tons)	4.8	4.2	4.1	4.2	5.0	4.4	5.2
Average Ship Age (Years)	19.4	19.0	19.2	20.2	18.0	16.4	18.0
Total Crew Size (Number of sailors)	100,000	102,000	102,000	103,000	106,000	109,000	114,000
Direct Operation and Support Costs for Ships ^c (Billions of 2007 dollars)	13.7	13.6	13.5	13.4	14.5	14.0	14.9
Number of Forward-Deployed Major Combatants	76	70	67	63	81	46	82
Number of Helicopter Hangars							
Forward deployed in peacetime	67	79	78	68	78	36	78
Surged in wartime	138	163	149	134	151	99	162
Number of VLS Cells							
Forward deployed in peacetime	3,200	3,200	3,000	3,100	3,100	2,100	3,300
Surged in wartime	6,900	7,000	6,600	6,800	6,700	5,600	7,100
Total Covert-Mission Days Provided by Attack Submarines	2,800	2,800	3,100	2,800	2,800	2,700	2,900
Number of Targets Attacked per Day by Carrier Aircraft in Wartime	3,900	3,900	3,900	4,000	3,900	3,500	4,000
Number of Guns Providing Naval Fire Support in Wartime (At 13/63/83 nautical miles)	78/29/6	81/31/10	72/23/0	72/23/0	82/33/10	63/0/0	82/33/10
Total Lift Capacity (MEBs)	3.9	3.8	3.8	3.8	4.1	5.1 ^d	4.0

Continued

Summary Table 2.**Continued**

	Option 1 (Across-the- board cuts)	Option 2 (Surface combatants)	Option 3 (Submarines)	Option 4 (Aircraft carriers)	Option 5 (Sea basing)	Memorandum:	
						Current Fleet ^a	Navy's 2006 Shipbuilding Plan
Capabilities in 2035							
Number of Battle Force Ships	217	246	219	189	255	285	294
Number of Strike Groups	19	21	18	17	18	36	24
Total Full-Load Displacement ^b (Millions of long tons)	3.6	3.0	3.0	3.1	3.9	4.4	5.0
Average Ship Age (Years)	18.0	17.6	17.4	18.0	17.9	16.4	16.3
Total Crew Size (Number of sailors)	65,000	66,000	68,000	73,000	72,000	109,000	99,000
Direct Operation and Support Costs for Ships ^c (Billions of 2007 dollars)	9.2	9.4	9.0	9.3	10.0	14.0	13.1
Number of Forward-Deployed Major Combatants	57	60	51	43	74	46	74
Number of Helicopter Hangars							
Forward deployed in peacetime	57	84	66	56	66	36	72
Surged in wartime	127	190	133	123	139	99	172
Number of VLS Cells							
Forward deployed in peacetime	1,900	2,000	1,800	1,700	1,700	2,100	2,400
Surged in wartime	4,100	4,600	3,800	3,700	3,500	5,600	5,400
Total Covert-Mission Days Provided by Attack Submarines	1,900	1,700	3,100	1,700	1,700	2,700	2,400
Number of Targets Attacked per Day by Carrier Aircraft in Wartime	2,300	2,300	2,900	4,200	2,300	3,500	4,200
Number of Guns Providing Naval Fire Support in Wartime (At 13/63/83 nautical miles)	33/33/6	35/35/10	29/29/0	29/29/0	43/43/10	63/0/0	41/41/10
Total Lift Capacity (MEBs)	3.2	3.0	3.0	3.0	3.3	5.1 ^d	4.0

Source: Congressional Budget Office.

Note: VLS = vertical launch system; MEB = Marine expeditionary brigade.

a. At the beginning of 2006.

b. The weight of a ship when it is fully equipped and loaded with weaponry, crew, and supplies.

c. Direct operation and support costs are those directly related to the number of ships in the fleet (such as costs for fuel, supplies, and compensation of personnel).

d. Includes all three conventional maritime prepositioning squadrons, even if they are deployed to Iraq.

Introduction

After declining in the 1990s following the Cold War, defense spending has risen sharply in recent years. As part of that increase, spending on Navy shipbuilding averaged nearly \$12 billion annually between fiscal years 2002 and 2005—16 percent higher than in the last four defense budgets of the Clinton Administration. (Unless otherwise noted, all costs cited in this report are in 2007 dollars.) For 2006, the Congress appropriated about \$10 billion for ship construction (excluding money to repair damage from Hurricane Katrina) and increased the number of ships purchased. For 2007, the Navy has requested \$11 billion. Given the Navy's current and planned shipbuilding programs, however, those levels of spending, if maintained indefinitely, would not be sufficient to keep the fleet at the current size of about 285 battle force ships.

This study by the Congressional Budget Office (CBO) examines the prospects for modernizing the fleet at a time when both the Navy's future missions and the amount of money it will have to spend on ship construction are uncertain. This chapter reviews the Navy's current structure, its evolving missions, the threats it may face in the future, and changes in its numerical requirements for ships since the end of the Cold War. Chapter 2 describes the Navy's plan for modernizing its fleet and the budgetary implications of that plan through 2035. Chapters 3 and 4 analyze five lower-cost alternatives to the Navy's modernization plan and assess the capabilities that each alternative would provide.

Composition and Organization of the Navy's Fleet

In the past decade and a half, both the size and structure of the Navy's fleet—what it calls its ship battle forces—have changed significantly. The total number of ships has fallen by half since 1990, although the composition of the fleet has remained about the same (see Table 1-1). Today's fleet comprises 285 combat and support ships:¹

- 12 aircraft carriers;
- 14 ballistic missile submarines;
- 53 nuclear-powered attack submarines;
- 4 guided missile submarines (which are converted ballistic missile submarines);
- 102 surface combatants (cruisers, destroyers, and frigates);
- 35 amphibious warfare ships; and
- 65 logistics, support, and mine warfare ships.

(For more information about the roles that those different types of ships play, see Summary Box 1 on page xiii.)

Most of those vessels are operated by the Navy, but 34 of the logistics and support ships are operated by the Military Sealift Command (MSC), the organization charged with providing sea transportation services for the Department of Defense. The MSC ships are designated as the Naval Fleet Auxiliary Force. Although the MSC is headed by a Navy vice admiral, most of the personnel on its ships are civilian mariners.

The Military Sealift Command also operates 145 ships that are not considered part of the Navy's battle force fleet. They include 36 prepositioning ships stationed overseas, most of which store equipment for use by brigade-sized units of the Army and Marine Corps; 26 sealift ships, which are used to transport supplies and equipment overseas in the event of a conflict; 24 other special-mission ships; the Navy's two hospital ships (which are

1. With the commissioning of new ships and the decommissioning of old ones, that number changes frequently. The figure of 285 was the number in the Navy's fleet at the beginning of 2006.

Table 1-1.**Distribution of the Navy's Battle Force Ships, 1990 and 2006**

	1990		2006	
	Number of Ships	Percentage of the Fleet	Number of Ships	Percentage of the Fleet
Aircraft Carriers	15	3	12	4
Ballistic Missile Submarines	35	6	14	5
Attack Submarines	97	17	57 ^a	20
Surface Combatants	213	37	102	35
Amphibious Ships	66	11	35	12
Combat Logistics Ships	60	10	32	11
Mine Warfare Ships and Fleet Auxiliaries	88	15	33	12
Total	574	100	285	100

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

a. Includes four Ohio class ballistic missile submarines that have been converted to a conventional (guided missile) configuration.

also part of the Naval Fleet Auxiliary Force); and the 57 ships in the Ready Reserve Fleet, which are mostly sealift ships kept in reduced operating status until they are needed for a war.² This study focuses only on the Navy's battle force ships and the 16 MSC prepositioning ships that station Marine Corps equipment overseas—called the Maritime Prepositioning Force.

Most naval vessels deploy in groups rather than on their own. The Navy currently organizes its ships around 36 strike groups:

- 12 carrier strike groups (each composed of an aircraft carrier, three surface combatants, an attack submarine, and a combat logistics ship);
- 11 expeditionary strike groups (each consisting of three amphibious warfare ships, three surface combatants, and one attack submarine);
- 9 surface action groups (each made up of three surface combatants); and
- 4 guided missile submarines (each of which acts as its own strike force).

2. The Ready Reserve Fleet is maintained by the Department of Transportation's Maritime Administration, but it would be operated by the Military Sealift Command if the ships were activated for service.

That organization, which was introduced in 2002 and 2003, represents a substantial change from the Navy's structure at the end of the Cold War. Before the reorganization, the Navy counted only 19 strike groups: 12 carrier battle groups (each with six surface combatants rather than three) and seven surface action groups. The fleet's amphibious ships were organized into 12 amphibious ready groups, which generally operated without the support of surface combatants. By adding guided missile submarines—and by distributing surface combatants and attack submarines among the amphibious ready groups to create expeditionary strike groups—the Navy is able to provide strike capability in a greater number of places with a smaller fleet.

In addition to ships, the Department of the Navy has a total of about 4,000 planes and helicopters, 900 of which belong to the Marine Corps. The overwhelming majority of those aircraft support the Navy's 10 active and one reserve carrier air wings, the Marines' three active and one reserve air wings, and the Navy's four land-based patrol and reconnaissance wings. Today, each carrier air wing is composed of 44 strike fighters, four EA-6B electronic attack aircraft, four E-2C airborne early-warning planes, and 12 helicopters. Each patrol wing consists of about 25 P-3 aircraft (including training and reserve aircraft); those wings perform reconnaissance and antisubmarine missions. Nearly 700 aircraft are associated with the Navy's and Marines' various training squadrons.

Missions of the Navy

The Navy fills a variety of peacetime and wartime roles in support of U.S. national security. Although its peacetime missions have remained much the same over the past 15 years, its potential wartime missions have altered considerably.

The ways in which the Navy uses its forces and deploys them overseas in peacetime has not changed significantly with the end of the Cold War or the advent of the war on terrorism. The Navy's peacetime missions include conducting exercises with friendly nations, enforcing sanctions, responding to humanitarian crises, performing antidrug operations, "showing the flag" (visibly patrolling the world's oceans), and ensuring the freedom of the seas against any entity that might try to restrict it. In addition, since the terrorist attacks of September 11, 2001, the Navy has conducted more operations to provide homeland security in U.S. coastal waters.

The missions that the Navy would expect to perform in wartime have changed substantially since the end of the Cold War. If the rivalry between the United States and the Soviet Union had led to a war in Europe, the Navy's primary responsibilities would have been to destroy Soviet ballistic missile submarines, defend convoys crossing the Atlantic from attack by long-range Soviet aircraft and cruise missiles, and conduct independent strike operations along the edges of the Soviet Union. Such a war would have involved large-scale conflict between two sizable blue-water navies (those designed to operate in the open ocean).

In the post-Cold War era, the United States no longer faces a large naval opponent, nor is one considered likely to exist in the next 10 years. The missions that the Navy has performed in support of operations in Iraq, Serbia, and Afghanistan have included large and small strike missions using land-attack missiles and carrier-based aircraft, the sinking of enemy naval forces (which were very small), and antimine operations.

In the future, the Navy may be expected to perform the following missions in wartime, against either a large or a small opponent:

- *Sea Control.* Ensuring the freedom of the seas—with force, if necessary—has been the most common naval mission historically. A classic sea-control mission for

the Navy was reflagging and escorting oil tankers through the Persian Gulf to deter attacks on them during the Iran-Iraq War of the 1980s. In a war with the Soviet Union, sea control would have meant ensuring that convoys made it across the Atlantic to the European theater. In future military operations, the most demanding sea-control mission may be defeating enemies' area-denial strategies and antiaccess networks in littoral (coastal) regions. (That threat is discussed in more detail in the next section of this chapter).

- *Sea Denial.* Whereas sea control means ensuring freedom of movement at sea, sea denial involves using naval forces to deny an opponent access to the world's oceans. Wartime blockades—such as the one that the United States practiced against Japanese commercial shipping during World War II or that the Union imposed on the Confederacy in the Civil War—are classic sea-denial operations. Sea denial is often thought of as a poor man's naval strategy because it requires fewer forces to deny access to the seas than to control them directly. (Germany's submarine campaigns in World Wars I and II illustrate that point.) Since the end of the Cold War, sea denial has been an easy mission for the U.S. Navy to perform because its opponents (Iraq, Serbia, and Afghanistan) have had few or no fighting ships. In the future, the United States might employ a large-scale sea-denial strategy if it found itself fighting an opponent with a substantial navy or significant merchant marine.
- *Land Attack and Support of Joint Forces on Shore.* Attacking targets or supporting troops on land has been among the Navy's most common missions over the past 15 years. During the 1990s, the Navy attacked land targets in numerous punitive or antiterrorist operations in Iraq and elsewhere. It also supported land operations in Iraq, Serbia, and Afghanistan through strikes with Tomahawk missiles and carrier-based aircraft. Although those operations did not require it, the Navy could also have provided gunfire support to forces operating near the shore or conducted an amphibious assault with Marine Corps units aboard amphibious warfare ships. In a more unorthodox example, during Operation Enduring Freedom in Afghanistan, the air wing of a Navy carrier was reduced substantially to make room for Army special-operations forces and helicopters, and the carrier was used as a floating base for special-operations mis-

sions.³ Both the Navy and Marine Corps are rethinking how they will perform land-attack and support missions in the future (as described in more detail later in this chapter).

- **National Missile Defense.** The Navy expects that technological developments will allow it to play a prominent role in defending the United States and U.S. troops and allies abroad against ballistic missiles. Depending on the ultimate configuration of a national missile defense system, Navy ships may carry radars to detect enemy missile launches and incoming warheads as well as carry and launch the missiles to intercept those enemy missiles.⁴ The Navy is planning its next generation of cruisers largely with the missile-defense mission in mind.

In short, compared with the Cold War or operations in the past 15 years, future wars would be likely to involve a different focus for sea control, a similar role for sea denial, much greater emphasis on land attack and support of operations ashore, and a completely new mission (national missile defense). It is that future for which Navy leaders must plan the type and number of ships that the service will need to buy.

Future Naval Threats

Determining the right size and mix of naval capabilities depends not only on the general types of peacetime and wartime missions that the Navy can expect to perform but also on the specific naval threats that the United States is apt to face. A great deal of uncertainty exists about the nature and scope of threats 20 or 30 years in the future, however, so making appropriate decisions about ship procurement is extremely difficult. For example, the Navy made large investments in attack submarines and Aegis cruisers and destroyers in the 1980s to counter the threat posed by the Soviet navy. That threat collapsed with the end of the Cold War in 1989. Nevertheless, although the Navy has adapted its ships for the post-Cold War period, many of its current vessels were designed and built during the Cold War and tailored to meet the specific threats of that era.

3. Fred Lewis, "Despite Splendid Deeds, Navy Remains Target of Budget Ax," *National Defense* (April 2002).

4. See Congressional Budget Office, *Alternatives for Boost-Phase Missile Defense* (July 2004).

Today, naval planners worry about two relatively specific threats that could emerge in the next 10 to 20 years: a strengthened Chinese navy and the possibility that terrorists could use or target ships. Planners are also concerned about a more generic threat: the ability of hostile nations to buy fairly cheap weapons that would make it difficult for the U.S. Navy to operate in some areas.

China

Above all others, the specific potential threat that concerns much of the Navy's leadership and many Members of Congress is a new naval competition with the People's Republic of China.⁵ The future relationship between China and the United States remains uncertain. However, China is investing substantial resources in improving its military capabilities—especially those that would make it harder for U.S. forces to come to the aid of Taiwan in the event of a military confrontation with the mainland. In particular, observers of China's naval programs note with concern that country's investments in quiet conventional and nuclear-powered submarines, antiship cruise missiles based on land as well as at sea, and tactical and theater ballistic missiles.⁶ Such observers argue that attempting to counter those systems should be of paramount importance in determining the naval capabilities that the United States needs to pursue in the future.

Terrorist Groups

The other specific threat that many naval planners consider a high priority is the war on terrorism. Fears that terrorist organizations could use ships as delivery platforms for chemical or biological weapons or could attack commercial vessels might cause the Navy to change the way it conducts military operations and affect the num-

5. See, for example, Department of Defense, Office of the Secretary of Defense, *Annual Report to Congress: Military Power of the People's Republic of China, 2006* (May 2006); and Dave Ahearn, "Mullen Wary on Huge Chinese Military Buildup," *Defense Today* (March 15, 2006). Some observers worry as much about a renewed naval competition with Russia, especially if oil prices remain high in coming years. Russia has retained its ability to build highly capable, very quiet submarines equipped with modern weapons.

6. For a comprehensive overview of those investments, see Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Naval Capabilities—Background and Issues for Congress*, Report for Congress RL33153 (Congressional Research Service, February 13, 2006). Also see Bernard D. Cole, *The Great Wall at Sea: China's Navy Enters the Twenty-First Century* (Annapolis, Md.: Naval Institute Press, 2001); and Lyle Goldstein and William Murray, "Undersea Dragons: China's Maturing Submarine Force," *International Security* (Spring 2004), pp. 125-160.

bers and types of ships it would need to buy.⁷ Conceivably, the war on terrorism could include a large, highly distributed effort at sea control to provide maritime security. Such an effort would require widespread interagency cooperation within the United States and assistance from other nations.⁸ Even so, the Navy might need larger numbers of smaller ships than it has bought in the past.

The force structure required to conduct a long-term anti-terrorism naval campaign could look very different from the force structure needed to counter China's naval power 25 years from now. An antiterrorism naval campaign would probably require many small, lightly armed surface combatants. Such vessels would not be appropriate for fighting a near-peer competitor, such as China may be in the future. They would probably be highly vulnerable to the relatively sophisticated antiship weapons that China would use in a conflict with the United States.

Denial of Access to a Specific Area

The more generic threat that motivates U.S. naval planners is the need to counter area-denial and antiaccess strategies by other countries (including China). The Navy's fear is that nations whose interests conflict with the United States' will be able to buy advanced, but relatively inexpensive, weapons that will make U.S. military action very costly. The weapons that the Navy worries about most are mines; antiship cruise missiles; small, fast attack boats; and diesel-electric submarines (especially those with closed-cycle, air-independent propulsion systems, which can remain underwater for weeks and are extremely quiet).

The Defense Department's 2001 Quadrennial Defense Review was explicit in saying that the Navy must be transformed to defeat area-denial threats: "Antiship cruise

missiles, advanced diesel submarines, and advanced mines could threaten the ability of U.S. naval and amphibious forces to operate in littoral waters. New approaches for projecting power must be developed to meet these threats."⁹ However, if the Navy develops the weapons and forces necessary to counter China's fleet, it will probably also be able to destroy another country's area-denial forces, which are unlikely to be more sophisticated or numerous than the area-denial forces that might be fielded by China.

The Evolution of the Navy's Goals for Battle Force Ships

Since the end of the Cold War, planners have given widely varying answers to the question: How many ships does the Navy need? From the base force proposed during the first Bush Administration to the Navy's recent proposal for a 313-ship fleet, the objective for the total number of battle force ships has varied significantly (see Figure 1-1), along with the assumptions that have undergirded those goals.

Stated Requirements from 1990 to 2001

In the 1980s, the Navy envisioned a 600-ship fleet, and the number of battle force ships reached 594 in 1987. The first change from the 600-ship goal was the base-force initiative of the first Bush Administration, which called for a force of 451 ships. That initiative focused largely on what the Navy should keep from the vast shipbuilding effort of the previous decade; it paid less attention to where the Navy should invest in the future.

The base force was the starting point for subsequent efforts by the Department of Defense (DoD) and the Navy to determine the correct size for the fleet. The analyses that followed explicitly considered what capabilities the Navy needed to do particular tasks, even though much of the attention after the analyses were published focused on the suggested numbers of battle force ships. The tension between numbers and capabilities would appear repeatedly in debates about the size and composition of the Navy.

The 1993 Bottom-Up Review (BUR)—which was analogous to the more recent Quadrennial Defense Reviews—concluded that a fleet of 346 ships by 1999 could "carry

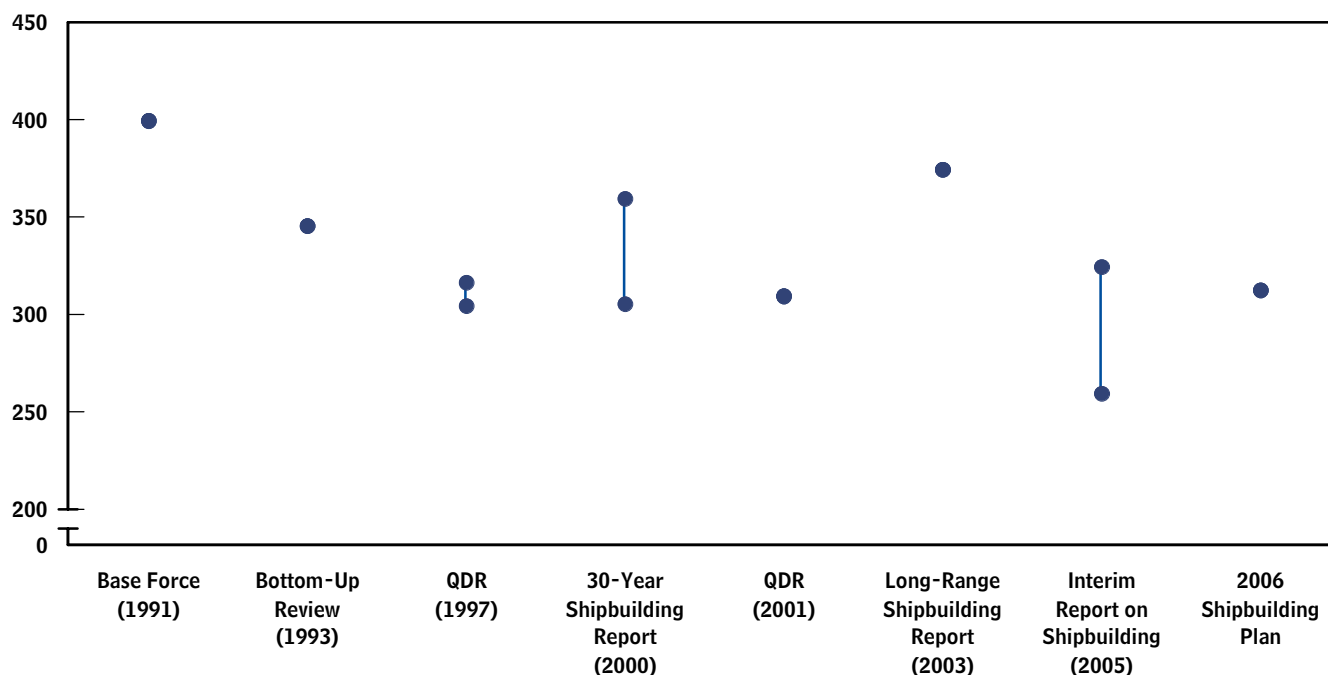
7. See, for example, Captain James Pelkofski, "Before the Storm: Al Qaeda's Coming Maritime Campaign," *Proceedings*, U.S. Naval Institute (December 2005). Other analysts have questioned whether the Navy has a large role in the war against terrorism. See Hank Gaffney, "The Global Security Environment and the Role of the U.S. Navy out into the Future" (presentation given at the Future Naval Plans and Requirements Conference of the Institute for Defense and Government Advancement, April 24, 2006).

8. The Navy has begun to address that issue through its concept of a 1,000-ship global maritime network, in which protecting sea lanes would require the combined naval forces of many countries sharing information. See Vice Admiral John G. Morgan and Rear Admiral Charles W. Martoglio, "The 1,000-Ship Navy Global Maritime Network," *Proceedings*, U.S. Naval Institute (November 2005), pp. 14-17.

9. Department of Defense, *Quadrennial Defense Review Report* (September 30, 2001), p. 31.

Figure 1-1.

Number of Ships the Navy Needs, According to Various Defense Department Analyses



Source: Congressional Budget Office.

Note: QDR = Quadrennial Defense Review.

out our strategy and meet our national security requirements.”¹⁰ The overall thrust of the BUR was that the demand for peacetime naval missions required a larger force structure than did prospective wartime missions. Ten carrier battle groups and 45 to 55 attack submarines were considered necessary to fight two nearly simultaneous regional wars (the defense policy standard throughout the 1990s). But the desire to maintain more overseas presence with aircraft carriers and fulfill peacetime missions meant maintaining a 12-carrier force.

In explaining the overseas presence mission, the BUR report stated: “U.S. forces abroad protect and advance our interests and perform a wide range of functions that contribute to our security. . . . The flexibility of our carriers, and their ability to operate effectively with relative independence from shore bases, makes them well suited to overseas presence operations.”¹¹ The report implied that

although 15 carriers would be desirable to provide full-time presence in Europe, the Middle East, and the western Pacific, a 12-carrier force represented a prudent balance between cost and the risks associated with having gaps in overseas carrier presence.

The 1997 Quadrennial Defense Review (QDR) made few changes to the BUR force. It reiterated the requirement for 12 carrier battle groups and 12 amphibious ready groups. However, it also reduced the goal for surface combatants from more than 130 to 116 and split the difference on attack submarines, setting the requirement at 50.¹² Overall, the results of the review implied a battle force of 305 to 317 ships. (As smaller numbers of newer, more capable ships replaced larger numbers of less capable ships, the force could shrink and still maintain the capabilities desired in the QDR.) The 1997 QDR report contained little analysis supporting its conclusions about the size and composition of the Navy’s forces.

10. Secretary of Defense Les Aspin, *Report of the Bottom-Up Review* (October 1993), p. 28.

11. *Ibid.*, pp. 23-24.

12. Secretary of Defense William S. Cohen, *Report of the Quadrennial Defense Review* (May 1997).

In June 2000, in response to a mandate in the National Defense Authorization Act for Fiscal Year 2000, the Navy submitted the *Report on Naval Vessel Force Structure Requirements* to the Congress. That document—commonly referred to as the 30-Year Shipbuilding Report—described the ship construction plans necessary to maintain the QDR force of around 300 ships. At the same time, it warned that the fleet was “heavily tasked” and had “little elasticity left . . . to respond to an emergent crisis in one region without having to reduce forward naval presence in another.”¹³ Consequently, the report outlined a larger Navy of some 360 ships that it called the “Future Force—Reducing the Risk.” That fleet would include 15 carrier battle groups, 14 amphibious ready groups, and substantial increases in the number of surface combatants and submarines.

In 2001, the first Quadrennial Defense Review of the current Bush Administration did not propose a particular force structure for the Navy. It declared an objective of transforming the military over time and said that the current force of about 310 ships would be the foundation on which transformation would occur.¹⁴ However, before September 11, 2001, numerous press reports indicated that the Secretary of Defense was seriously considering reducing the number of carrier battle groups to 11.¹⁵

Sea Power 21 and the Navy's Plan for a 375-Ship Fleet

Against the backdrop to the Bush Administration's plans to transform the military, the Navy put forward its transformation vision, called Sea Power 21, in 2002. That vision rests on three key concepts—Sea Strike, Sea Shield, and Sea Basing—connected by a fourth, ForceNet.

Sea Strike represents the Navy's efforts to support joint campaigns by projecting offensive power from and through littoral areas around the world. Such offensive power could take the form of strikes by carrier-based aircraft, naval guns, or missiles launched from surface com-

batants and submarines; information or electronic attack warfare (such as disrupting an enemy's communications or command-and-control systems); or landings or assaults by Marine Corps ground units.

Sea Shield is the defensive counterpart to Sea Strike. It encompasses the capabilities that defend or screen Navy ships at sea from attack, protect joint and allied forces operating on shore from air and missile attack, and protect the United States from conventional and unconventional threats. As now conceived, Sea Shield would eventually include theater and perhaps national missile defense systems.

Sea Basing is considered by many defense officials to be the most transformational of the three concepts: it envisions that future landings of Marine units ashore will be conducted, supported, and sustained from ships at sea. Today, such operations would be supported and sustained primarily from supply depots on land, located either at an existing base provided by a host nation or on territory seized during the assault. Future sea-based operations would forgo putting “iron mountains” of supplies, fuel, and ammunition ashore and instead keep them at sea, rearming and replenishing Marine forces on shore only when needed.

Binding those three concepts together is ForceNet, a term the Navy uses to describe its overall approach to linking networks, sensors, communication systems, and warfighting units to provide a common operational picture in a battlefield environment. ForceNet and various supporting networks (such as the Cooperative Engagement Capability and the Naval Fires Network) represent the Navy's efforts to pursue network-centric warfare, which DoD views as one of the most important elements of military transformation.¹⁶ According to the most concrete

13. Secretary of Defense William Cohen, *Report on Naval Vessel Force Structure Requirements* (June 26, 2000), p. 3.

14. Department of Defense, *Quadrennial Defense Review Report* (September 30, 2001).

15. The reduction to 11 aircraft carriers was finally made an explicit DoD (and Navy) objective in the 2006 QDR. That goal was the only specific number of Navy ships endorsed in the report. See Department of Defense, *Quadrennial Defense Review Report* (February 6, 2006).

16. For more information on network-centric warfare and its application to the Navy, see Ronald O'Rourke, *Defense Transformation: Background and Oversight Issues for Congress*, Report for Congress RL32238 (Congressional Research Service, February 17, 2006), and *Navy Network-Centric Warfare Concept: Key Programs and Issues for Congress*, Report for Congress RS20557 (Congressional Research Service, February 14, 2006). For an argument in favor of the network-centric warfare concept, see Office of the Secretary of Defense, Office of Force Transformation, *Alternative Fleet Architecture Design* (January 31, 2005). For a criticism of the ForceNet approach, see Malina Brown, “Van Riper: Navy's ForceNet Too Broad, Mysterious to be Meaningful,” *Inside the Navy* (July 5, 2004).

statement of the subject, the objective of ForceNet is “near instantaneous collection, analysis, and dissemination of information coupled to advanced computer-driven decision aids . . . unify[ing] the battle space of the 21st century.”¹⁷

The Navy hopes that linking all of its systems through ForceNet will eventually increase military capability substantially by allowing for a more widely dispersed, but still networked, fleet of ships and aircraft. Such a fleet is considered capable of covering more territory, seeing more of an enemy's operations, and conducting defensive or offensive operations with virtually any weapon in the force. Not unlike sea basing, ForceNet is still in the early stages of implementation and will have to overcome many technical challenges to fulfill the hopes of senior Navy and DoD leaders.

To carry out the first steps of the Sea Power 21 vision, the Navy introduced the Global Concept of Operations in 2002. It involved reorganizing the Navy from 19 strike groups to 37, in part by operating surface combatants and submarines with amphibious ships to create expeditionary strike groups. The Chief of Naval Operations at that time stated that the reorganization and the Global Concept of Operations required a fleet of approximately 375 ships.¹⁸

Shortly thereafter, in response to a requirement in the National Defense Authorization Act for Fiscal Year 2003, the Navy submitted a report to the Congress outlining a plan to build a fleet of 375 ships.¹⁹ The report argued that the larger number of ships was necessary to carry out the Navy's peacetime and wartime missions in support of U.S. military strategy. Unlike the 30-Year Shipbuilding Report released in 2000, that plan did not envision a larger carrier force or more amphibious ships. Instead, it included 56 littoral combat ships, which it described as relatively small surface combatants designed to counter threats posed by mines, submarines, and small boats in littoral areas. Those ships represented almost all of the

proposed increase in the Navy's force structure from the 2001 QDR force of 310 ships.

The Navy's Plan for 260 to 325 Ships

After publishing the 2003 long-range report, senior Navy leaders concluded that the service did not have enough budgetary resources to build a 375-ship fleet. In March 2005, the Navy released *An Interim Long-Range Plan for the Construction of Naval Vessels for FY2006*. It included projected inventories for a 260-ship fleet and a 325-ship fleet through 2035, suggesting that the Navy's total requirement might fall within that range. In testimony before the Congress, senior naval leaders stated that the Navy could reduce its requirement from 375 ships to between 260 and 325 ships by making greater use of technology, rotating crews to ships while the ships are deployed overseas (thus allowing them to spend more time in their area of operations), and basing some vessels in Guam and Japan rather than the United States.²⁰

Numbers Versus Capabilities

The arguments that Navy leaders put forward in defense of significantly reducing the 375-ship requirement were consistent with the broader contention that numbers of ships are less relevant to gauging the strength of the fleet than are the capabilities that those ships provide. As the size of the fleet has declined over the past few years, Navy leaders have often stated that the fleet's capabilities are more important than the raw number of ships. In 2005, the Secretary of the Navy told Members of Congress that: “Today's 290 ship Navy is much more capable than the more than double the size Navy of the late 1980s. Numbers still matter, but only when carefully balanced with capabilities.”²¹ Some senior Navy admirals have made similar arguments, as has the Secretary of Defense.²²

Others, however, have countered that numbers are important in any assessment of fleet strength. When arguing in favor of the 375-ship fleet, the former Chief of Naval Operations, Admiral Vern Clark, stated that, “You can

17. Vice Admiral Richard W. Mayo and Vice Admiral John Nathman, “ForceNet: Turning Information into Power,” *Proceedings*, U.S. Naval Institute (February 2003), p. 42.

18. Admiral Vern Clark, “Sea Power 21: Projecting Decisive Joint Capabilities,” *Proceedings*, U.S. Naval Institute (October 2002), p. 38.

19. Department of the Navy, *A Report to Congress on Annual Long-Range Plan for the Construction of Naval Vessels* (May 2003).

20. See, for example, the statement of Admiral Vern Clark, Chief of Naval Operations, before the Senate Armed Services Committee, February 10, 2005.

21. Statement of Gordon R. England, Secretary of the Navy, before the House Armed Services Committee, February 17, 2005. (England is now Deputy Secretary of Defense.)

22. Dave Ahearn, “Rumsfeld Says He Doesn't Oppose Increase in Navy Fleet,” *Defense Today* (January 26, 2006).

only be in one place at one time with one ship and so numbers do matter. Numbers do have a quality all their own.”²³ Former Secretary of the Navy John Lehman worried that by reducing the fleet, “We’re creating a vacuum in the Pacific. You cannot have a stabilizing, deterring presence in the world with 289 ships.”²⁴ And the former director of the Office of Force Transformation, Admiral Arthur Cebrowski, argued that a fleet of 500 to 800 smaller, less capable combatants networked together was the right answer for the Navy’s future force structure. In his view, the network would be the key to providing the capabilities needed by the fleet, and the larger the number of linked systems, the stronger the network.²⁵

As a practical matter, divorcing numbers of ships from capabilities is difficult to do in assessing fleet requirements. A given capability must eventually be translated into the weapons and systems necessary to provide it. Yet determining what capabilities the Navy needs and what amount of those capabilities is required to carry out the Navy’s role in U.S. military strategy necessarily involves a great deal of uncertainty. Further, the mode by which a given set of capabilities is provided—such as smaller numbers of more capable systems or larger numbers of less capable platforms—is also uncertain.

Most of the ships that the Navy is building today and plans to build in the near future are unquestionably more capable than their predecessors built a generation ago. Nonetheless, the Navy is now experimenting with smaller, less capable platforms and has begun building the littoral combat ship, a surface combatant much smaller than anything the Navy has produced in 40 years.

Operating Changes for Battle Force Ships

According to senior Navy officials, the main reason for continued uncertainty about the Navy’s future force structure is that the ultimate effects of some innovative

concepts being pursued by the service are still unknown. Those concepts include the Fleet Response Plan, a new method of surging the fleet (stepping up the speed and quantity of ship deployment in wartime); forward home porting (basing more ships overseas); and Sea Swap, a procedure for rotating crews to forward-deployed ships to increase the amount of time they spend on-station (in their area of operations). In addition, according to some analysts, the role of unmanned systems could and should greatly influence the size and composition of the future fleet.

Fleet Response Plan

After the attacks of September 11, 2001, and the start of combat operations in Afghanistan and Iraq, the Navy’s senior leadership decided to seek the ability to deploy more aircraft carriers to a crisis or conflict, if required. As a result, the Navy developed the Fleet Response Plan (FRP), which is designed to change the way the service conducts its training and maintenance of aircraft carriers, as well as some other ships. Under the previous carrier deployment cycle, only three or four ships out of the 12 in the fleet would be available at any given time to go to a theater of operations within 30 days. Under the FRP, the Navy would keep the carrier force in a higher average state of readiness so that six of the 12 carriers could deploy within 30 days and another two could deploy within 90 days.²⁶ In the summer of 2004, the Navy conducted a fleet experiment to test out the new system and reported satisfactory results.²⁷

The long-term impact of the Fleet Response Plan on the Navy’s readiness, training, and budget have yet to be determined. Some critics have argued that there is not enough funding to maintain the high level of pilot training that is required under the FRP for carrier air wings to

23. Gopal Ratman, “U.S. Navy Wrestles with Fleet Size, Abilities,” *Defense News* (July 1, 2002), p. 4.

24. Robert Hamilton, “Lehman: U.S. Fleet Is Already Too Small for Safety,” *The Day* (New London, Conn.), February 20, 2005.

25. Aarti Shah, “Cebrowski Recommends Large Fleet of Small, Less Expensive Ships,” *Inside the Navy* (February 7, 2005). Also see Office of the Secretary of Defense, Office of Force Transformation, *Alternative Fleet Architecture Design* (January 31, 2005).

26. Before the Fleet Response Plan, when an aircraft carrier returned from a deployment, many of its personnel were immediately transferred and the ship underwent large maintenance projects. Under the FRP, if the carrier is one of those that must remain available to deploy, personnel transfers and maintenance are performed more judiciously so as not to undermine the ship’s ability to deploy again at relatively short notice.

27. Malina Brown, “In New Exercise, Navy to Surge Seven CSGs to Spots Around the Globe,” *Inside the Navy* (June 7, 2004); and Malina Brown and Christopher J. Castelli, “Mullen: Results from Summer Pulse ‘04 ‘Incredibly Good’ So Far,” *Inside the Navy* (July 5, 2004).

be deployed at short notice.²⁸ The House of Representatives has included a provision in the defense authorization act for 2007 to prohibit the Navy from expanding the FRP to other ships for the time being.

Because the Fleet Response Plan might allow the Navy to deploy more carriers and other ships to a crisis more rapidly than in the past, the overall wartime requirement for those ships might decline. For example, senior Navy and DoD leaders have explicitly stated that the Navy could reduce its carrier force to 11 because of its ability to surge ships—meaning that a smaller force could now surge the same number of carriers to a crisis as a larger force could before.²⁹ That might also prove true for other types of ships as the Navy evaluates its fleet requirements.

The Fleet Response Plan is applicable only during crises or wartime, however. Providing more overseas presence during peacetime with fewer ships (surface combatants, at least) is the subject of other Navy initiatives.

Forward Basing

Although the Navy already bases a portion of its fleet outside the United States, it has indicated that it plans to transfer more ships to overseas ports. Today, a carrier strike group and an expeditionary strike group are based permanently in Yokosuka and Sasebo, Japan, respectively. The ships in Yokosuka comprise one conventionally powered aircraft carrier, one command ship, and eight surface combatants. In Sasebo, the Navy has four amphibious ships, two minesweepers, and one salvage ship. In addition, two attack submarines and a submarine tender are stationed on the Pacific island of Guam (with a third attack submarine to follow shortly), another submarine tender is stationed in Italy, and four minesweepers are based in the Persian Gulf.

The Navy has studied options for basing six more submarines and a squadron of cruisers and destroyers in Guam, at a cost of about \$1 billion in additional infrastructure. It has also looked at basing an aircraft carrier in Guam,

but that would require another several billion dollars, at least, to improve the facilities on the island.

Ships based overseas spend more of their time on-station than do ships based in the continental United States, because they have shorter transit times to their operating areas and use different operating concepts that provide additional days on-station.³⁰ For example, even when Navy ships based in Japan put to sea for a training exercise or visit another port for shore leave, they are considered to be performing the mission of showing the flag. As a consequence, the Navy counts those ships as providing overseas presence full time, even when they are training or simply tied up at the pier. In addition, ships based overseas can respond to most crises faster than can ships located in the United States (unless the crisis occurs in the Western Hemisphere). Thus, forward-based ships would also help to meet the requirement for ships in the first days of a war.

Sea Swap

Perhaps the most significant break with past practice that the Navy is considering is to rotate crews to forward-deployed ships. In the past, the crew of a surface combatant would typically spend about 18 months training, performing maintenance, and resting at its home port (in the United States) before taking its ship on a six-month deployment and then bringing the ship home. To increase the amount of time that ships can spend conducting missions, the Navy has begun experimenting with a multiple-crewing concept called Sea Swap on some surface combatants. (The Navy has long used a system of dual rotating crews on ballistic missile submarines.)

Under one version of Sea Swap, three crews and three ships are rotated in such a way as to keep one surface combatant deployed away from its home port for 18 months. The first crew takes the ship out on deployment, while the other two crews continue with their training and maintenance cycles on two other ships. After six months, the second crew flies to an overseas location to meet the deployed ship and relieve the first crew. Six months later, the third crew relieves the second crew and then brings the ship home for maintenance at the end of the 18-month period. That approach is being used on some Arleigh Burke class destroyers.

28. See Government Accountability Office, *Defense Logistics: GAO's Observations on Maintenance Aspects of the Navy's Fleet Response Plan*, GAO-04-724R (June 18, 2004). For a critique of the Fleet Response Plan, see Lieutenant B.W. Stone, "A Bridge Too Far," *Proceedings*, U.S. Naval Institute (February 2005), pp. 32-33.

29. Christopher J. Castelli, "Congress Presses Officials on Shipbuilding Issues, Carrier Retirement," *Inside the Navy* (February 21, 2005).

30. See Congressional Budget Office, *Increasing the Mission Capability of the Attack Submarine Force* (March 2002), pp. 10-11.

The benefits of Sea Swap may be significant. According to the Navy, three ships that each deploy from the United States and return independently after six months will provide a total of 300 days on-station over an 18-month period. By eliminating a ship's transit time to and from the United States, the Sea Swap concept increases the total amount of presence provided by about 38 percent (including time for crews to turn over). Thus, one Sea Swap vessel is equivalent to 1.38 ships deploying independently. The new operating concept essentially lets the Navy provide more presence with its existing force of ships—or provide the same amount of presence with a smaller force—compared with ships that do not use Sea Swap.

The Navy has tried some variations of that approach on other types of surface combatants, but the amount of increased presence was slightly less than 38 percent. The Navy has also studied the feasibility of applying Sea Swap to amphibious ships and aircraft carriers, but it appears to have concluded that the concept would be too difficult to carry out on such large vessels.

Ultimately, the Navy envisions using more crews than ships to perform the rotations—for instance, alternating four crews among three ships over a period of years. In particular, the Navy plans to use such an approach on its new littoral combat ships and future Zumwalt class destroyers.³¹ That approach could yield perhaps 25 percent more presence than the version of Sea Swap used on the Arleigh Burke destroyers.

Sea Swap's long-term potential is not yet certain, however. As recently as three or four years ago, senior Navy admirals feared that rotational crewing concepts would be too challenging to implement. They voiced concerns about whether a crew would feel sufficient attachment to a ship, whether crews would receive enough training, and

whether the deployed ship would be well maintained—all of which could reduce retention among the rotating crews. In 2004, the Government Accountability Office raised concerns that the Navy had not provided enough guidance for implementing and learning lessons from Sea Swap, nor had the Navy fully assessed the impact on ship maintenance.³² A survey of sailors after the first Sea Swap experiments found that most participants did not like rotational crewing and that, if it became standard, they would be less likely to stay in the Navy. In recent legislation, Members of the House of Representatives have raised similar concerns. Senior admirals have said that Sea Swap is a dramatic change in the Navy's culture and thus will take time for people to adjust to.³³

Senior Navy leaders are now saying that Sea Swap is the way of the future. They contend that the Navy must increase the amount of time its ships spend on-station in order to reduce the number of ships that the service needs to buy.³⁴ In a speech to the Surface Navy Association in early 2005, Admiral Clark explicitly stated that Sea Swap had swayed his thinking about the number of ships the Navy requires.³⁵

An Unmanned Revolution?

In the longer term—10 years or beyond—the size of the Navy's fleet could be influenced by the introduction of unmanned aerial, surface, and underwater vehicles. As those systems mature and ships employ more of them, an individual ship's capability to locate, track, and attack targets could increase substantially. Several observers have gone so far as to say that 20 or 30 years from now, the Navy's ships will be little more than trucks, carrying unmanned systems that are off-loaded to do all of the

31. Littoral combat ships will initially operate with a dual-crew concept similar to that used on ballistic missile submarines. However, once enough of the ships have been commissioned, the Navy will operate them with four crews for three ships in order to keep one on-station overseas. The first crew will take the ship out on its deployment and begin routine operations. After four months, a new crew will take over for another four months. That cycle will continue until the fourth crew brings the ship back to its home port. When one crew is not assigned to a ship, it will train on shore to prepare for its next deployment. Members of the extra crew can also serve to replace members of the crews assigned to ships, if necessary.

32. Government Accountability Office, *Force Structure: Navy Needs to Fully Evaluate Options and Provide Standard Guidance for Implementing Surface Ship Rotational Crewing*, GAO-05-10 (November 10, 2004).

33. Dale Eisman, "Crew-Swapping Success Carries a Cost," *Virginian-Pilot*, July 14, 2004; and Jason Ma, "Navy Pleased with Sea Swap Results, But Retention Problems Possible," *Inside the Navy* (July 19, 2004).

34. See Christopher J. Castelli, "Navy Wants to Cut Number of Strike Groups, Slash LPD-17 Shipbuilding," *Inside the Navy* (April 26, 2004); and Dave Ahearn, "Adm. Nathman Says Perhaps Just 40 to 50 LCSs Required," *Defense Today* (June 24, 2004).

35. Christopher J. Castelli, "On Shipbuilding Challenge, Clark Talks of Confronting Realities," *Inside the Navy* (January 17, 2005).

work.³⁶ Moreover, if the promises of ForceNet are realized and those unmanned systems become part of the

battle force network, their utility for the Navy may be greater still.

However, the Navy is only in the very early stages of developing and incorporating unmanned systems into its fleet. The eventual numbers, costs, and impact of unmanned systems remain highly uncertain, although they have the potential to affect the way the Navy conducts all major types of warfare.

36. Christopher Cavas, "U.S. Fleet of Mother Ships: Will Swarms of Tiny Unmanned Vehicles Replace Large Vessels?" *Defense News* (November 15, 2004); and "U.S. Analyst Says UUVs, Not Submarines, Are the Key to Maritime Supremacy," *Jane's Defence Weekly* (April 28, 2006).

The Navy's Current Plan for Modernizing the Fleet

In the summer of 2005, the new Chief of Naval Operations, Admiral Michael Mullen, ordered a reexamination of the Navy's previous shipbuilding plan, which envisioned a fleet of between 260 and 325 battle force ships. Admiral Mullen said the review was intended to arrive at a single numerical requirement for the fleet and to provide stability in the year-to-year construction of naval vessels so that both the Navy and the shipbuilding industry could plan efficiently for whatever ships were ordered.

In February 2006, the Navy submitted its new 30-year shipbuilding report to the Congress, which calls for a fleet of 313 ships.¹ That number would be the permanent requirement around which the actual number of ships would rise and fall, depending on when ships were retired from the fleet and on what budgetary resources were available for buying new ships.² Although the plan covers a 30-year period, Navy officials have stated that the requirement is aimed at dealing with expected threats and contingencies in 2020.³ The 313-ship requirement consists of:

- 11 aircraft carriers;
- 14 strategic ballistic missile submarines;
- 48 attack submarines;
- 4 guided missile submarines (SSGNs);
- 62 Arleigh Burke class destroyers;

- 7 DDG-1000 Zumwalt class destroyers;
- 19 CG(X) cruisers;
- 55 Freedom class littoral combat ships (LCSs);
- 31 amphibious ships;
- 12 future maritime prepositioning force, or MPF(F), ships; and
- 50 support ships.

That fleet would be organized around 33 strike groups: 11 carrier strike groups, nine expeditionary strike groups, nine surface action groups, and four SSGN strike forces. However, if the Navy ultimately adopted Sea Swap for all of its Arleigh Burke destroyers and its new classes of large surface combatants, that fleet could provide the same amount of peacetime overseas presence as 44 strike groups would today, the Congressional Budget Office estimates.

Major Weapons Programs

The new 30-year shipbuilding plan encompasses a wide array of ship and (by implication) aircraft programs. Additional details about the Navy's procurement plans through 2011 come from the 2006 defense appropriation and authorization laws and from the Future Years Defense Program (FYDP) that was prepared as part of the President's 2007 budget request. (The ship purchases envisioned in the 2007 budget are consistent with the new shipbuilding plan.)

The Navy proposes to buy 51 ships between 2007 and 2011—one aircraft carrier, five submarines, six large surface combatants, 23 small surface combatants, 11 amphibious and maritime prepositioning ships, and five support ships (see Figure 2-1). Over the same period, the

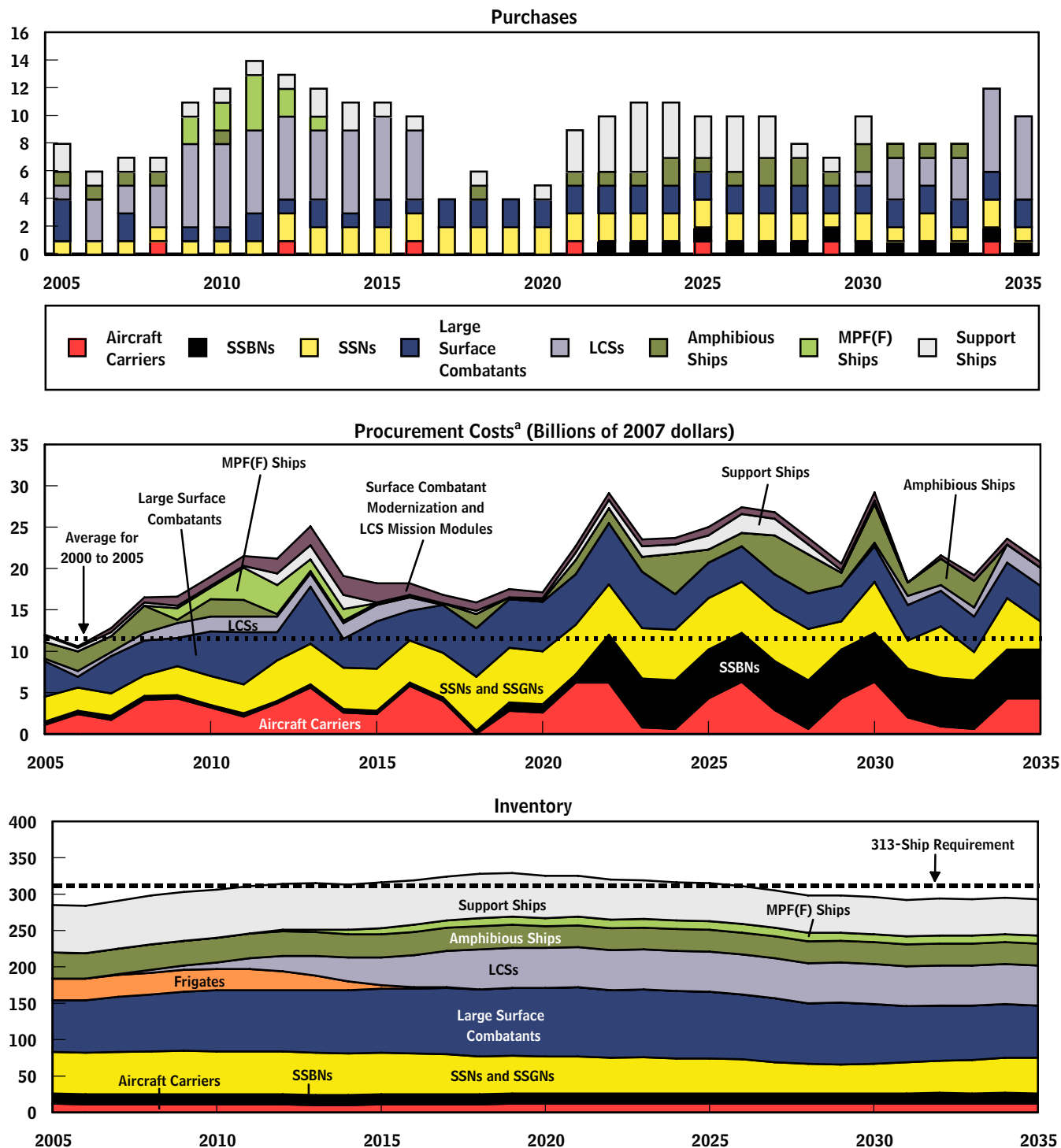
1. Department of the Navy, *Report to Congress on Annual Long-Range Plan for Construction of Naval Vessels for FY2007* (February 2006).

2. Christopher P. Cavas, "U.S. Ship Plan to Cost 20% More: Price Control Will Be Key to Funding 313-Vessel Fleet," *Defense News* (December 5, 2005).

3. Geoff Fein, "The Art of Building a 313-Ship Fleet: Balancing Navy and Industry Needs," *Defense Daily* (May 1, 2006).

Figure 2-1.

Purchases, Costs, and Inventory of Battle Force Ships Under the Navy's 2006 Shipbuilding Plan



Source: Congressional Budget Office.

Note: SSBNs = ballistic missile submarines; SSNs = attack submarines; SSGNs = guided missile submarines; LCSs = littoral combat ships; MPF(F) = Maritime Prepositioning Force (Future).

a. Data for 2006 exclude supplemental funding related to Hurricane Katrina.

Navy plans to retire one aircraft carrier, one small surface combatant, eight amphibious ships, 13 support ships, and two minesweeping ships.⁴ Under the 2006 shipbuilding plan, the Navy would buy another 218 vessels between 2012 and 2035—six aircraft carriers, 44 attack submarines, 14 strategic ballistic missile submarines, 45 large surface combatants, 49 small surface combatants, 21 amphibious and maritime prepositioning ships, and 39 support ships.

The Navy also proposes to buy about 1,200 aircraft between 2007 and 2011. Under the 2006 shipbuilding plan, it would purchase an additional 2,600 aircraft between 2012 and 2035, CBO estimates.⁵

Current and Planned Ship Programs

The Navy plans to develop and build numerous new classes of ships over the next 30 years. They include a new type of nuclear-powered aircraft carrier, four kinds of surface combatants, a new class of submarine to carry strategic ballistic missiles, several types of amphibious and maritime prepositioning ships, and four different support ships (see Table 2-1). In addition, the Navy has begun building the Virginia class attack submarine, the first of which was commissioned in late 2004, and the LPD-17 amphibious ship, the first of which was commissioned in January 2006. The last of the 62 planned Arleigh Burke class guided missile destroyers were ordered in 2005 and will enter the fleet around 2010.

Nuclear-Powered Aircraft Carrier (CVN-21). The mainstay of the Navy's current carrier fleet is the Nimitz class, which was first designed in the 1960s. Ten of those ships will be serving in the fleet by 2010, and the last ship in that class, the *George Herbert Walker Bush* (CVN-77), could serve until about 2060.

A new, as yet unnamed, class of carriers (known currently as CVN-21s) is being designed to replace existing carriers as they retire.⁶ Although the CVN-21 class is using essen-

tially the same hull as the Nimitz class, its internal design and components will be substantially different. According to the Navy, key features of the CVN-21 will include:

- A new reactor and power system, which will provide up to three times the power of a Nimitz;
- An electromagnetic catapult system for launching aircraft, which will require much less maintenance and personnel to operate than the steam-powered catapults on current carriers; and
- Technological improvements to reduce the number of sailors needed to operate the ship by between 500 and 900, not including potential reductions in personnel for the carrier's air wing.

The new class will be built by the Newport News shipyard, which is owned by Northrop Grumman.

The Navy expects to order the first CVN-21 in 2008, at a cost of about \$4 billion to develop and \$11 billion to design and build. Subsequent ships, which would be bought roughly every four years, would cost about \$8 billion each to build. (In comparison, the final Nimitz class carrier cost about \$7 billion to build, with only a modest amount spent on development.) In return for that investment, the Navy anticipates that the CVN-21 will be able to launch 160 aircraft sorties a day for 30 days, compared with 120 to 140 sorties per day for the Nimitz class. New technologies—along with a reorganization of the flight deck, hangars, and aircraft elevators on the CVN-21—are intended to allow aircraft to be refueled, rearmed, and launched more quickly without unduly wearing down the flight-deck personnel. Like the Nimitz class, the CVN-21 will be about 1,100 feet long and displace (weigh) about 100,000 tons, with an expected service life of 50 years.

Questions have been raised, however, about whether the Navy should continue to build such large and expensive ships. A vessel displacing more than 100,000 tons may prove to be vulnerable in the types of environments where U.S. naval forces may have to operate in the future.

4. The Congress has prohibited the Navy from having fewer than 12 operational aircraft carriers. If that prohibition was lifted, the Navy would retire two aircraft carriers in the next five years.

5. The aircraft program between 2012 and 2024 is based on Congressional Budget Office, *The Long-Term Implications of Current Defense Plans and Alternatives: Summary Update for Fiscal Year 2006* (October 2005). Beyond 2024, CBO assumed one-for-one replacement of old aircraft with new models as the former retire at the end of their service life.

6. The Navy is referring to the program to develop the new carrier as the CVN-21 (for 21st century) program. The first ship to emerge from that program will be the Navy's 78th aircraft carrier and thus will be numbered CVN-78. As a result, the new class will eventually be known as CVN-78s or by whatever given name that first ship receives.

Table 2-1.**New Classes of Ships Scheduled to Enter the Fleet Through 2035**

New Class	Year First Ship Is Authorized	Year First Ship Is Commissioned	Quantity to Be Purchased Through 2035	Existing Ships Being Retired		
				Current Class	Quantity Now in Service ^a	Year First Ship Retires
Aircraft Carriers						
CVN-21	2008	2015	7	Kitty Hawk (CV-63)	1	2008
				Enterprise (CVN-65)	1	2013
				John F. Kennedy (CV-67)	1	2006 ^b
				Nimitz (CVN-68)	9	2025
Surface Combatants						
Freedom (LCS-1)	2005	2007	76 ^c	Oliver Hazard Perry (FFG-7)	30	1994
Zumwalt (DDG-1000) ^d	2007	2012	7	Spruance (DD-963)	1	1998
CG(X)	2011	2016	19	Ticonderoga (CG-47)	24	2004
DDG(X)	2023	2028	25	Arleigh Burke (DDG-51)	62 ^e	2026
Submarines						
Virginia (SSN-774)	1998	2004	30	Los Angeles (SSN-688)	49	1995
Improved Virginia	2020	2026	27			
SSBN(X)	2022	2029	14	Ohio (SSBN-726)	14	2027
Amphibious Ships						
San Antonio (LPD-17)	1996	2006	9	Austin (LPD-4)	11	2004
LHA-6/LHD(X)	2007	2012 ^f	8	Tarawa (LHA-1)	4	2006 ^g
				Wasp (LHD-1)	7	2029
MPF(F) (various)	2009	2012	12			
LSD(X)	2018	2022 ^f	12 ^f	Whidbey Island (LSD-41)	8	2022
				Harpers Ferry (LSD-49)	4	2032
Support Ships						
Lewis and Clark (T-AKE)	2000	2006	11	Kilauea (AE-26)	5	2010
				Sacramento (AOE-1)	3	2005
T-ATF(X)	2013	2015	4	Powhatan (T-ATF-166)	4	2015
T-AO(X)	2018	2022	15	Henry J. Kaiser (T-AO-187)	14	2022
T-AGOS(X)	2021	2025	4	Victorious (T-AGOS-19)	3	2024
				Impeccable (T-AGOS-23)	1	2031
ARS(X)	2022	2026	4	Safeguard (ARS-50)	4	2026
T-AOE(X)	2025	2029	4	Supply (T-AOE-6)	4	2029

Source: Congressional Budget Office.

Note: Ships with a "T-" designation refer to vessels operated by the Military Sealift Command. For the meaning of other letter designations for ships, see Summary Box 2 on page xiv.

- a. At the beginning of 2006.
- b. The Navy proposes to retire the *John F. Kennedy* in 2006, but it must obtain Congressional authorization to do so.
- c. Includes replacements bought in the 2030s for Freedom class littoral combat ships that retire after 25 years of service.
- d. Formerly known as the DD(X).
- e. There are 48 DDG-51s in service today, but the Navy has ordered a total of 62.
- f. Projected.
- g. *Belleau Wood*, the first LHA-1 to retire, will be replaced by *Makin Island*, the last of the LHDs.

The Department of Defense's Office of Force Transformation has suggested that the Navy buy aircraft carriers that are half the size of the CVN-21 in order to have more of them, distributed over a wider area. (The office has also said that the Navy should consider buying dozens of very small ships, with displacements of a few thousand tons, that are capable of carrying aircraft.)⁷ Former Secretary of the Navy Gordon England (now the Deputy Secretary of Defense) told the Congress that in the future, the Navy will probably move toward using smaller carriers.⁸

Littoral Combat Ship. The Navy's newest surface combatant, the first of which was ordered last year, is a small vessel designed to operate in coastal areas. The littoral combat ship—dubbed the Freedom class—has a displacement of about 2,800 tons (roughly the size of a large corvette).⁹ According to Navy officials, it is intended to be a focused-mission ship rather than a multimission or single-mission ship. It is being designed modularly so that it can be reconfigured fairly quickly to perform one of three main missions: locating and sinking quiet diesel submarines in crowded, noisy, shallow coastal waters; finding and neutralizing mines; and countering attacks by swarms of small, high-speed boats armed with missiles. The LCS would also be capable of performing a number of routine tasks, such as showing the flag, enforcing sanctions or pursuing other maritime interception operations, countering drug smugglers, supporting special-operations forces, engaging with allies, and providing transport within a theater of operations.¹⁰

Navy officials have characterized the LCS as a truck capable of carrying various cargoes. The truck—consisting of the ship's hull, propulsion plant, crew quarters, and basic defensive combat systems—will be developed and acquired separately from its three associated mission packages. The operators of the ship and of the mission pack-

ages would train separately. When an LCS was slated to deploy, whichever mission package was called for would be put on the ship and sent to sea.¹¹

Although the final design and cost of the LCS have not yet been determined, the 2006 shipbuilding plan calls for the Navy to buy 55 ships. Thus far, two contractor teams have submitted proposals to build the LCS, and the Navy will buy two of each to determine which team will build the rest. (The Navy could also decide to build both types in order to maintain competition in the program.) The first LCS was ordered in 2005 and is being built by a team led by Lockheed Martin. The Navy expects to order three more LCSs in 2006: another from Lockheed Martin and two built by a team led by General Dynamics.

The Navy is determined to keep the costs of the littoral combat ship low so the service can procure them in large numbers. Specifically, it does not want the "truck" portion of the LCS system to cost more than \$220 million apiece in 2005 dollars (or \$235 million in 2007 dollars). However, the latest shipbuilding plan implies that the LCSs purchased through 2011 will have an average cost of around \$300 million each just for the ships themselves. Limiting the cost of the mission modules—some of which are still in development and whose costs are uncertain—could also be problematic. Relying on the Navy's budget submission, this report assumes that one LCS with two mission packages would cost an average of about \$450 million.

Observers have raised three key issues about the littoral combat ship:

- **Size.** Different critics maintain that the LCS is either too small or too large. The Office of Force Transformation proposed several ideas for surface combatants that were one-third to one-30th the size of the LCS. Other analysts argue that the LCS will be too small to defend itself against missiles or larger surface combatants that it might encounter.¹²

7. Office of the Secretary of Defense, Office of Force Transformation, *Alternative Fleet Architecture Design* (January 31, 2005).

8. Christopher J. Castelli, "Navy Secretary Anticipates 'A New Navy' with 'Smaller Deck Carriers,'" *Inside the Navy* (March 7, 2005).

9. Corvettes are small, maneuverable, lightly armed warships (between the size of a patrol boat and a frigate) that various countries use for coastal duty.

10. Geoff Fein, "Navy Examining Potential Missions, Including MIO, for Littoral Combat Ship," *Defense Daily* (February 23, 2006).

11. See Richard R. Burgess, "Changes to Littoral Combat Ship Components May Speed Reassignments of the Multimission Vessel," *Sea Power* (February 2006).

12. For a discussion of that issue, see Government Accountability Office, *Defense Acquisitions: Plans Need to Allow Enough Time to Demonstrate Capability of First Littoral Combat Ship*, GAO-05-255 (March 2005).

- *Process.* The Navy did not conduct a formal study to determine whether the LCS was the right ship to perform the missions of antimine, antisurface, and anti-submarine warfare before it decided to proceed with the program.¹³
- *Logistical Support.* As a relatively small ship, the LCS may experience more wear and tear from the sea than larger ships do. Although the Navy wants to keep a large number of LCSs forward deployed, its plans for supporting and maintaining the ships are not yet clear.

Zumwalt Class Destroyer. The next generation of large surface combatant, the DDG-1000 Zumwalt class destroyer—previously known as the DD(X)—is not intended primarily to replace a particular class of ship that is being retired. Instead, it is intended to introduce new technologies that the Navy views as essential to the design of its future warships. It is also intended to provide a capability that the fleet currently lacks: high-volume naval gunfire in support of troops on shore. The former Chief of Naval Operations declared that, “The DD(X) is critical to the Navy’s future. Our future cannot unfold without it. DD(X) is the heart of our Family of Ships.”¹⁴ The current Chief of Naval Operations has also strongly endorsed the Zumwalt. However, the program has also experienced a substantial increase in potential costs, delays in its schedule, and questions about the relevance of its mission.

The Zumwalt destroyer is intended to be a multimission ship, with an emphasis on land attack. Its main battery would consist of two 155-millimeter (mm) Advanced Gun Systems, each of which can fire rocket-assisted precision-guided projectiles up to 83 miles.¹⁵ The ship would also have a battery of 80 vertical launch system cells capable of firing various land-attack and self-defense missiles, a large helicopter hangar, and sophisticated radars and other combat systems. Together, those features

would give the new destroyer more capability than existing Arleigh Burke destroyers have—with the exception of providing fleet air defense in open oceans. The Zumwalt could also operate boats or unmanned vehicles from a special boat ramp. The ship is expected to have a displacement of about 14,500 tons. It would be built by either Bath Iron Works, owned by General Dynamics, or Ingalls Shipbuilding, owned by Northrop Grumman.

Three new technologies are particularly important for the Zumwalt destroyer:

- The ship is being designed with an all-electric power-distribution and propulsion system. If it works successfully, such a system will allow the Navy to divert power from propulsion to weapons and back again—paving the way for the development of shipboard, electronically powered weapons such as long-range electromagnetic guns (which may be able to shoot nonexplosive projectiles at high speeds for more than 200 miles) or lasers. The promise of being able to deploy such advanced weapons is far from being realized. But should they come to fruition, the Zumwalt might have the available space, weight allowance, and power system to accommodate them.
- The destroyer would incorporate a new hull form, materials, conformal antennas (embedded directly in the skin of the ship), and other design features to give it a very small radar cross-section, as well as low magnetic, infrared, and acoustic signatures.
- The Zumwalt is intended to have a high degree of automation that would allow it to be operated by a crew of 140 people (including the aviation detachment), about half that on an existing destroyer.

The Zumwalt program has had a troubled history. Its first incarnation was as the DD-21 land attack destroyer during the Clinton Administration. At that time, the Navy’s goal was to buy the first ship in 2004 and to bring the cost of the destroyer down to \$1.1 billion apiece (in 2007 dollars) by the fifth ship.¹⁶ In 2001, the Bush Administration canceled the DD-21 and immediately reconstituted it as the DD(X) program. For several years, the Navy anticipated that the first DD(X) would be purchased in 2004 and that the ships would cost \$1.2 billion

13. See Ronald O’Rourke, *Navy Littoral Combat Ship (LCS): Background and Issues for Congress*, Report for Congress RS32105 (Congressional Research Service, November 16, 2005).

14. Admiral Vern Clark quoted in Rear Admiral Mark Edwards, “Navy Destroyers from Bainbridge to DD(X): Fast Ships That Go in Harm’s Way,” *Surface SITREP* (newsletter of the Surface Navy Association), vol. 20, no. 4 (December 2004), p. 7.

15. Captain C. H. Goddard and Commander C. B. Marks, “DD(X) Navigates Uncharted Waters,” *Proceedings*, U.S. Naval Institute (January 2005), pp. 30-33.

16. In 1996 dollars, the cost goal was \$750 million by the fifth ship.

to \$1.4 billion each.¹⁷ Under the 2006 shipbuilding plan, the Navy now envisions buying a total of seven Zumwalt destroyers, at an average cost of \$2.8 billion. In contrast, CBO estimates that the average cost of the seven ships will be \$3.8 billion each (see Table 2-2).¹⁸ The Navy plans to order the first two Zumwalts in 2007.

Some observers have questioned whether the principal mission of the new destroyer is still warranted. Although the ship's centerpiece, its two advanced gun systems, would give the Navy the ability to provide sustained, high-volume fire support to troops ashore, that capability has not been in high demand in the United States' past several conflicts. If the Zumwalt had been available, it would have been of no use against land-locked Afghanistan and of very little use against Iraq, where U.S. forces invaded from neighboring Kuwait and moved rapidly out of range of a Zumwalt's guns. In the future, if U.S. forces do not have access to a base such as Kuwait and must perform an opposed amphibious landing from the sea, the new ship's guns could prove valuable. But the United States has not conducted such a landing in more than half a century, although it has had opportunities to do so.¹⁹

CG(X) Cruiser. The third new surface combatant that the Navy is planning, a guided missile cruiser, would be geared toward providing air defense for the fleet as well as theater and national missile defense. Although the design of the CG(X) remains uncertain, the 2006 shipbuilding plan calls for buying 19 of them, beginning in 2011. Ships of that type are normally built by either Bath Iron Works or Ingalls Shipbuilding.

The new cruiser was originally expected to share the same hull, propulsion plant, and basic combat systems as the Zumwalt destroyer. In 2004, the Navy stated that the

Table 2-2.

The Navy's and CBO's Estimates of the Costs of Major New Ships

(Billions of 2007 dollars)

Program	Average per-Ship Cost over the 2006-2035 Period ^a	
	Navy ^b	CBO ^c
CVN-21 Aircraft Carrier	9.4	9.6 ^d
DDG-1000 Zumwalt Destroyer	2.8	3.8
CG(X) Cruiser	2.7	3.9 ^e
DDG(X) Destroyer (Replacement for Arleigh Burke class)	1.9	2.7 ^e
Virginia Class Attack Submarine	2.1	2.7
SSBN(X) Ballistic Missile Submarine (Replacement for Ohio class)	3.1	6.1
Amphibious Ships	1.4	2.3

Source: Congressional Budget Office.

- The total amount of money spent on a ship program from 2006 through 2035 divided by the total number of ships bought in that program.
- Based on a briefing given by the Navy to CBO and the Congressional Research Service, February 10, 2006.
- CBO's estimates are generally based on past relationships between cost and weight for individual types of ships. The estimates assume that inflation in the naval shipbuilding industry will continue to exceed inflation in other Department of Defense procurement programs (see Box 2-2 on page 29).
- Because the Navy's estimate for the CVN-21 program was higher than an estimate based on a historical relationship between cost and weight, CBO relied on the Navy's estimate, adjusted for the higher level of inflation expected in the shipbuilding industry.
- Estimates of average costs for large surface combatants are higher in this study than in testimony that CBO gave before the Projection Forces Subcommittee of the House Armed Services Committee in March because CBO assumed then that these ships would be built by a single shipyard. However, consistent with Congressional direction on splitting the DDG-1000 program between two yards and the Navy's assumption that it will use two yards to build the CG(X), CBO changed its assumption for large surface combatants. Having two shipyards build a type of vessel raises the unit cost of the ships because of the additional overhead costs of supporting two yards rather than one.

17. At that time, CBO estimated that the DD(X) would have an average cost of \$1.9 billion per ship (in 2003 dollars), based on a design of 16,000 tons and a total purchase of 24 ships. See Congressional Budget Office, *Transforming the Navy's Surface Combatant Force* (March 2003).

18. See the statement of J. Michael Gilmore, Assistant Director for National Security, Congressional Budget Office, "The Navy's DD(X) Destroyer Program," before the Subcommittee on Projection Forces of the House Armed Services Committee, July 19, 2005.

19. The most recent opposed amphibious landing by U.S. forces occurred at Inchon, South Korea, in 1950.

CG(X) would probably be a larger ship—perhaps on the order of 20,000 tons—with a variety of missile launchers suitable for handling different threats. More recently, some Navy officials have again stated that the Zumwalt and the CG(X) would share the same (now smaller) hull and basic systems.²⁰

Specifications and requirements for the CG(X) are still not defined officially; thus, any estimate of its cost would be very preliminary. However, in light of the Navy's desire to put more-sophisticated combat systems on the CG(X) than on the Zumwalt, average costs are likely to be higher for the cruiser than for the destroyer. For the purposes of this analysis, CBO assumed that the CG(X) would have a displacement of about 14,500 tons, the same as the Zumwalt. Consequently, CBO estimates that the first CG(X) could cost about \$5 billion, with an average cost of about \$3.9 billion over the 19-ship program.

CBO assumed in this analysis that the cruiser would have a service life of 35 years and that its combat systems would be upgraded midway through that span. Alternatively, the Navy could consider more than one type of cruiser, depending on whether it needed all of its cruisers to have a high level of capability. The Navy could also decide to divide the CG(X)'s capabilities between cruisers and other ships.²¹

DDG(X) Future Guided Missile Destroyer. One of the largest uncertainties in the Navy's 2006 shipbuilding plan is what a replacement for the existing Arleigh Burke (DDG-51) class destroyers would look like. The Navy has a requirement for 62 DDGs and thus would need to begin replacing retiring Arleigh Burkes in the 2020s. The service has not yet indicated what size and capabilities a new "DDG(X)" class might have, since the ship would not need to be purchased for at least 15 more years. In its 2006 plan, the Navy assumed that those ships would cost no more than \$1.9 billion apiece, but it provided no details or specifications to indicate how big the ship would be or what capabilities it would have. Presumably, however, it would be at least as capable as the DDG-51s that the Navy is building today.

For this analysis, CBO assumed that the DDG(X) would have a displacement of about 11,000 tons, compared with about 9,200 tons for the latest Arleigh Burke destroyers. A new radar-evading hull form could add as much as 1,000 tons to the current ship's design. CBO also allotted 800 tons for growth in the weight of other ship systems, as often occurs when new technologies are introduced.

Judging from the historical cost-to-weight ratio of the Arleigh Burke class, CBO estimated that the first DDG(X) could cost about \$4.1 billion. The average cost of the new destroyers would be about \$2.7 billion if two ships were bought per year from separate shipyards. CBO did not estimate how many DDG(X)s the Navy would purchase in all because the end of the program would be well beyond the 30-year period of this analysis.

Virginia Class Submarine (SSN-774). The Navy's new Virginia class of nuclear-powered attack submarine will replace the Los Angeles class, which was built in the 1970s and 1980s. In development since the early 1990s, the first Virginia class submarine was ordered in 1998 and commissioned in late 2004. Six more submarines were ordered through 2005, and the Navy plans to order another six (at a rate of one per year) through 2011. The submarines are being built jointly by Northrop Grumman's Newport News shipyard and General Dynamics's Electric Boat shipyard.

The Virginia class is the first ship to enter the battle force fleet with a design for the post-Cold War era. According to the Navy, its combat systems and weapons bays can be easily updated and changed as technology advances. The Virginia is also the quietest submarine in the world. Although it is capable of performing missions in the open ocean, its quietness and other capabilities make it far better suited to operating in littoral regions than its predecessors, the Los Angeles and Seawolf classes. Virginia class submarines have a displacement of 7,800 tons when fully submerged and an expected service life of 33 years.

Although the lead ship of the Virginia class remained on schedule throughout its construction, the costs of the program have risen substantially. Between 1995 and 2004, the Navy's estimate of those costs grew by 35 percent in real (inflation-adjusted) terms. Virginias now cost about \$2.6 billion apiece.

20. See, for example, Chris Johnson, "Navy Surface Warfare Director Supports Using DD(X) Hull for CG(X)" *Inside the Navy* (May 1, 2006).

21. Dave Ahearn, "Adm. Nathman: CG(X) Radar, Missiles Needn't Be on Same Ship," *Defense Today* (October 6, 2005).

The Navy currently plans to build 30 Virginia class submarines, with the procurement rate rising to two per year in 2012 and beyond. However (as discussed in more detail below), the size of the attack submarine force will begin to fall substantially in 10 years because the Navy is unlikely to build Virginias fast enough to replace Los Angeles class submarines, which will begin to be retired in large numbers after 2015.

The principal criticism of the Virginia program has been its cost. In response to the rising unit (per-ship) cost of those submarines, the Navy and DoD are considering alternative approaches to provide undersea warfare capabilities in the future. The Navy, in conjunction with the Defense Advanced Research Projects Agency, is looking at concepts that could yield a nuclear-powered submarine about half the size of a Virginia, but with all of the same capabilities, for between two-thirds and three-quarters of the Virginia's price tag. The main way to achieve that reduction in size and cost would be to use an all-electric drive system in which the drive shaft would be eliminated and replaced with small, podded motors mounted on the outside of the hull. Eliminating the drive shaft would save substantial space and (potentially) cost.

At the same time, the Office of Force Transformation argues that the Navy should reexamine the value of diesel-electric submarines, particularly those with closed systems, known as air-independent propulsion, that allow them to stay submerged for two to four weeks at very slow speeds. (Nuclear-powered submarines, by contrast, can stay submerged for months at high speeds.) Such submarines would cost far less than a Virginia and might be better suited to littoral areas because they would be much smaller than their nuclear counterparts.²² Conversely, nuclear-powered submarines can operate far from U.S. shores for months at a time and can redeploy quickly when necessary. Diesel-electric submarines could not do that and would probably require the support of a mother ship to deploy to their operating areas overseas.

SSBN(X) Ballistic Missile Carrying Submarine. The first of the Navy's 14 remaining Ohio class submarines, which

carry Trident ballistic missiles, will reach the end of its 42-year service life in 2027. If the Navy determines that it needs 14 SSBNs—as called for in the 313-ship requirement—it will have to start building replacements for those submarines in the early 2020s. Under the 2006 shipbuilding plan, the first SSBN(X) would be purchased in 2022, with procurement continuing at a rate of at least one per year through 2035.

With production still more than 15 years away, the Navy does not have a program or ship design for replacing the Ohio class submarines. Some senior Navy officials have stated that the SSBN(X) could be a variant of the Virginia class attack submarine to take advantage of existing designs and engineering efforts.²³ The technical feasibility of such an approach is uncertain, however. Although it would be possible to design and insert a ballistic missile section into a Virginia class submarine, the section could not be made large enough to accommodate existing D-5 missiles and still allow the submarine's crew to perform maintenance on the missile at sea, if necessary. Thus, a new SSBN design may be required to replace Ohio class submarines when they retire in the 2020s.²⁴ However, that new design could incorporate some elements of the Virginia class, such as the reactor and bow section, to help reduce costs.

In its 2003 long-range shipbuilding report, the Navy assumed that the first SSBN(X) would cost about \$5.5 billion, with succeeding submarines costing an average of \$4.2 billion. However, that report assumed that the first Virginia class submarine would cost \$3.8 billion (compared with an actual cost of \$4.9 billion) and that succeeding Virginias would cost an average of \$2.4 billion (the Navy is expecting to pay about \$2.6 billion for the ninth Virginia). A corresponding increase in estimated costs for the SSBN(X) could result in an average cost of \$4.6 billion for submarines after the first one.

For an alternative, CBO assumed that a new SSBN(X) could be designed to carry 16 missiles, rather than the 24 of the Ohio class, with a displacement of about 15,000 tons, or nearly double that of the Virginia class. (Ohio class SSBNs are 2.4 times larger.) On the basis of the

22. Christopher J. Castelli, "Defense Department Nudges Navy Toward Developing Diesel Submarines," *Inside the Navy* (March 7, 2005). Also see Robert A. Hamilton, "Fleet Studies Raise Prospect of Non-nuclear Submarines; Pentagon Office Backs More Boats for Less Cost," *The Day* (New London, Conn.), March 2, 2005.

23. Jason Ma, "Modified Virginia-Class Subs Eyed to Replace Ohio-Class SSBNs," *Inside the Navy* (October 18, 2004).

24. The Navy apparently does not consider designing a new missile to fit a modified Virginia class submarine to be cost effective.

price per thousand tons that the Navy is currently paying to build submarines, CBO estimated that a lead SSBN(X) of that size could cost around \$9 billion. Succeeding submarines would cost about \$4.9 billion each at today's prices for labor and materials. However, because inflation in the shipbuilding industry is expected to outstrip general inflation (as discussed later in this chapter), the cost of the succeeding SSBN(X)s could be around \$6 billion apiece (in 2007 dollars) by the 2020s.

LPD-17 Amphibious Transport Dock. The Navy's newest class of amphibious ships (which carry troops and equipment for Marine expeditionary forces) is the San Antonio (LPD-17) class amphibious transport dock.²⁵ Development of the LPD-17 began in 1990, and construction of the first ship was authorized in 1996. Those ships are intended to replace the Austin class LPD-4 transport docks, which will reach the end of their notional 40-year service life in the next 10 years. Although the original program envisioned buying 12 LPD-17s, the Navy now plans to procure a total of nine. It will have ordered eight of those ships by the end of 2006 and plans to buy one more in 2008. Most of the ships are being built by Northrop Grumman's Avondale Shipyard.

The decision to reduce the total purchase of LPD-17s has been controversial. Members of Congress have written to the Navy to express their concern about the reduction, and Marine Commandant Michael Hagee has stated publicly that, "In my professional opinion, the absolute bare minimum is nine. I have to think we're taking risks with nine. I would be much more comfortable with 10 LPD-17s."²⁶ The Navy's 313-ship requirement envisions 10 LPD-17s, but the 2006 shipbuilding plan includes only nine.

The construction program for the LPD-17 has been a troubled one, leading to an increase in the ship's cost. The 1996 Selected Acquisition Report for the program estimated that 12 LPD-17s would cost a little more than \$1 billion apiece, on average (in 2007 dollars). Eight

years later, that unit cost had grown by more than 50 percent—to an average of about \$1.6 billion per ship, CBO estimates.²⁷

LHA-6 Amphibious Assault Ship. The LHA-6 class—formerly LHA(R)—is intended to replace the current aging LHA-1 Tarawa class of amphibious assault ships. It may eventually replace the LHD-1 Wasp class as well. Officially, the Navy has selected a design for only the first LHA-6, called Flight 0; the design for subsequent ships is still to be determined. According to the 2006 Future Years Defense Program, the first LHA-6 will be authorized in 2007, the second in 2010, and remaining ships after 2011. The ship will have a displacement of 45,000 tons at full load or 30,000 tons at light load (without crew, materiel, weapons, or fuel). At that size, it will be 12 percent larger than the latest amphibious assault ship, the LHD-8, which is now under construction. Ingalls Shipbuilding is likely to build the future LHA-6s.

Although various elements in the Navy and the Marine Corps would have preferred a larger and more capable ship, concerns about the affordability of the LHA-6 have caused the Navy to design the first ship as essentially a repeat of the LHD-8. However, instead of a docking well (which would allow it to transport and deploy landing craft that move large equipment to shore), it will have enhanced aviation capabilities.

According to the 2007 FYDP, the Navy has programmed \$2.7 billion for the first LHA-6 and \$3.5 billion for the second, implying a much larger and more capable design for the second ship. CBO estimates that if all of the LHA-6s had the same basic design as the first one (in other words, if the larger follow-on design was discarded), the ships would cost an average of about \$2.7 billion each at current labor and materials costs.

The Navy's 2006 shipbuilding plan envisions buying only two LHA-6s for the amphibious forces. (Two more LHA-6s would be bought, in 2011 and 2013, for the maritime prepositioning forces, as discussed below.) In the 2020s and early 2030s, six of the Navy's existing LHD class ships would be replaced with a new LHD(X) design. CBO assumed that the LHD(X) would look very much like the LHA-6.

25. For more information about amphibious ships and their roles, see Congressional Budget Office, *The Future of the Navy's Amphibious and Maritime Prepositioning Forces* (November 2004); and Ronald O'Rourke, *Navy-Marine Corps Amphibious and Maritime Prepositioning Ship Programs: Background and Oversight Issues for Congress*, CRS Report for Congress RL32513 (Congressional Research Service, August 5, 2004).

26. Jason Ma, "Hagee Prefers 10 LPD-17s, Declares Nine the 'Absolute Bare Minimum,'" *Inside the Navy* (March 14, 2005).

27. For more about the cause of the cost growth, see Congressional Budget Office, *The Future of the Navy's Amphibious and Maritime Prepositioning Forces*, pp. 17-18.

The number of LHA-6s needed is directly related to the number of expeditionary strike groups that the Navy plans to have. Under the 313-ship requirement, the Navy would maintain nine expeditionary strike groups, each containing one LHA-6 or LHD class amphibious assault ship. The Navy now has or is building eight LHDs, one of which would be transferred to the MPF(F) squadron under the current plan. Thus, the Navy needs to buy only two LHA-6s in the near term. (The existing class of four LHAs is reaching the end of its service life and will be retired over the next few years.)

If the Navy decided to change the future number of expeditionary strike groups or if it moved toward having larger numbers of small-deck aircraft carriers (as the Deputy Secretary of Defense has suggested), the requirement for LHA-6s could increase. However, building a larger LHA-6—one capable of operating up to 30 Joint Strike Fighters—rather than building more CVN-21 aircraft carriers would increase the cost of the LHA-6 substantially.

Future Maritime Prepositioning Ships. The composition of the planned MPF(F) squadron has been one of the most uncertain elements of the Navy's shipbuilding program in recent years. Originally, the Navy and Marine Corps envisioned designing and building new types of ships that would incorporate various capabilities and technologies considered essential for the sea-basing mission. In the summer of 2005, however, they agreed to mainly use existing designs for amphibious and support ships (slightly modified) to create a sea-basing squadron. The virtue of that approach is that it relies mainly on ships already being built and thus reduces the risks that are inherent in designing a new class of ships with a set of capabilities that have never before put to sea.²⁸

According to a Navy briefing to the Congress, one MPF(F) squadron capable of deploying and sustaining a Marine expeditionary brigade would consist of:

■ Two LHA-6s;

- One LHD;
- Three large, medium-speed roll-on/roll-off ships of a modified design;
- Three T-AKE dry-cargo carriers;
- Three mobile landing platforms (a new design); and
- Two cargo ships from the existing maritime prepositioning squadrons.²⁹

The LHD would come from the Navy's inventory of amphibious ships, but the LHA-6s would be specially built for the MPF(F) squadron. Each squadron would also require a high-speed ship to transport the helicopters for an expeditionary brigade from the continental United States to the theater where the MPF(F) squadron was operating. The Navy estimates that such a squadron, including the high-speed ship, would cost \$11.1 billion. CBO estimates a slightly higher cost: \$13.0 billion.³⁰

Under the 2006 shipbuilding plan, the Navy would purchase only one MPF(F) squadron—down from as many as three just two years ago. Reports suggest, however, that some senior officers in the Marine Corps would prefer to buy two MPF(F) squadrons.

Today, the Navy has three conventional maritime prepositioning squadrons (MPSs) that can provide materiel and initial sustainment for three Marine expeditionary brigades. It is not clear whether the Navy would continue to maintain any of those conventional squadrons once it began investing in MPF(F) versions. For instance, if the Navy bought two MPF(F) squadrons, would it maintain one conventional squadron with existing ships or with replacement cargo ships? The cargo ships in the current MPSs could serve the Military Sealift Command for decades to come, but ships in the Ready Reserve Fleet will need replacing over the next 20 years. When the Navy first proposed building three new MPF(F) squadrons, the MPS cargo ships were intended to replace the

28. For example, the Analysis of Alternatives for the MPF(F) squadron, which was written by the Center for Naval Analyses, looked at a variety of alternatives to build the MPF(F) squadrons. Those alternatives varied from having each ship in the squadron designed with the same set of capabilities to building ships with more-specialized capabilities. Most of the ships in those alternatives would have been new designs.

29. Lieutenant General James A. Mattis, "Maritime Prepositioning Force (Future): Shipbuilding Requirements" (briefing by the Marine Corps Combat Development Command, June 2005).

30. See the statement of J. Michael Gilmore, Assistant Director, and Eric J. Labs, Principal Analyst, Congressional Budget Office, "Potential Costs of the Navy's 2006 Shipbuilding Plan," before the Subcommittee on Projection Forces of the House Armed Services Committee, March 30, 2006.

aging ships in the Ready Reserve Fleet. The ultimate status of those ships will not be determined until final decisions are made about the MPF(F). Furthermore, some observers suggest that the Marine Corps is unlikely to have enough ground equipment to furnish more than two MPF(F) or conventional squadrons in the future.

Support Ships. The Navy currently has about 50 support ships of various types, divided into two categories. The Combat Logistics Force (CLF) comprises 29 ships that are responsible for keeping deployed ships resupplied. They include triple-product ships, which provide fuel, ammunition, and dry goods (such as food) to carrier strike groups. The CLF also includes vessels that keep the triple-product ships and others resupplied, such as oilers and ammunition ships.

The Navy's remaining support ships, which number 17, serve various auxiliary functions. They include tenders, command ships, ocean-surveillance ships, salvage ships, and oceangoing tugs.

Under the 2006 shipbuilding plan, the Navy would maintain 30 vessels in the Combat Logistics Force and 20 other support ships. As ammunition ships and combat stores ships in the CLF are retired in the next decade, the Navy would not replace them on a one-for-one basis. Rather, those ships' roles would be filled by a new class of 11 Lewis and Clark dual-product (ammunition and dry cargo) vessels called T-AKEs.³¹ In the 2020s, the Navy would buy 15 oilers for the CLF as well as four triple-product ships to replace the four now in the force that would reach the end of their service life at that time. With respect to other support ships, the Navy's plan would buy two command ships in 2013 and 2014; four fleet ocean tugs between 2013 and 2016; and four ocean-surveillance ships, four salvage ships, and two submarine tenders in the 2020s.

Current and Planned Major Aircraft Programs

Along with 313 battle force ships, the Navy's current requirements call for a total of 4,000 aircraft. Most of those aircraft are used by the 10 air wings that deploy on aircraft carriers and by the reserve air wing (used primarily for training) that does not deploy.

The Navy plans to finish developing and acquiring several new types of aircraft over the next 20 years, including two strike fighters, one electronic warfare plane, a multi-mission support aircraft, and two large troop and cargo lift aircraft for the Marine Corps. In addition, the Navy intends to produce two or three new types of unmanned aircraft and two kinds of training aircraft. It also plans to upgrade many of its existing planes and helicopters.

F/A-18E/F Super Hornet. The multi-mission strike fighter Super Hornet began development in the 1990s as a successor to earlier models of the F/A-18 aircraft. The E/F version entered production in 1997. The Navy has bought 352 of the planes so far and hopes eventually to have 462. Under the Navy's current plan, the last F/A-18E/F would be purchased in 2011 and would enter the inventory in 2013.

With the retirement of the F-14 Tomcat, the Super Hornet will be the backbone of the Navy's carrier aviation for the next 10 to 15 years. At that point, the Navy intends to purchase large numbers of Joint Strike Fighters (JSFs) to replace earlier models of the F/A-18. (Currently, the Navy has 691 of those older aircraft.)

F-35 Joint Strike Fighter. Besides buying the F/A-18E/F, the Navy is participating with the Air Force in developing and building a family of strike aircraft that will have a high degree of commonality. One version of the Joint Strike Fighter would be designed to operate from aircraft carriers and would replace the Navy's earlier-model F/A-18s. Another version, with short takeoff and vertical landing (STOVL) capabilities, would replace the Marine Corps's AV-8B Harriers and F/A-18C/D Hornets.

According to the President's budget request for 2007, the Navy expects to buy about 680 JSFs, although it has not yet determined the final distribution between the carrier version and the STOVL version. The Navy plans to begin buying those aircraft in 2008, starting with the Marine Corps version. Under current plans, production would increase to 50 JSFs per year by 2015 and would continue until 2024. For this analysis, CBO assumed that the Navy would need to buy another 400 of the JSF (or some other new aircraft) between 2025 and 2035 to maintain its inventory.

F/A-18G Growler. The 10 squadrons of EA-6B electronic attack aircraft associated with the Navy's carrier air wings are reaching the end of their nominal service life. To re-

31. The T- in a ship name denotes that the vessel is operated by the Military Sealift Command.

place them, the Navy plans to use a variant of the F/A-18E/F airframe, designated G and named the Growler. Current plans call for buying the first four Growlers in 2006, with a total goal of 90 aircraft.

The Marine Corps has not yet decided what aircraft will replace its squadrons of EA-6Bs. A variant of the Joint Strike Fighter appears to be the most likely candidate.

Multimission Maritime Aircraft. In the next decade, the Navy plans to replace the P-3 aircraft used by its land-based reconnaissance squadrons with about 100 new Multimission Maritime Aircraft (MMA). Like the P-3, the MMA will be first and foremost an intelligence collector, focusing on antisubmarine and antisurface warfare. However, it will also be armed in case it needs to engage the various threats that it detects. The MMA, which is based on the airframe of the Boeing 737, is expected to perform those missions through 2035.

V-22 Osprey. The V-22 tilt-rotor aircraft has been in development since the late 1980s as a replacement for the Navy's fleet of medium-lift helicopters. The program has experienced cost overruns and several crashes. However, the Navy maintains that problems with the aircraft have been solved and that the service will ramp up to full-rate production by 2009. The Navy's goal is to acquire a total of about 400 V-22s, including those needed for maintenance and training purposes.

CH-53K. The current fleet of heavy-lift helicopters will reach the end of its nominal service life in the next decade. After considering many different replacements, the Navy and Marine Corps have decided to buy a new, upgraded version of the CH-53 heavy-lift helicopter, which will be capable of flying farther and with larger loads than current CH-53s can. CBO assumed that the first aircraft would be purchased in 2014, with a total objective of 156.

Budgetary Implications of the Navy's Plan

Assessing the resources that the Navy would need to carry out its latest modernization plan requires dealing with uncertainty about the design of numerous ships, particularly the future ballistic missile submarine, guided missile cruiser, and guided missile destroyer. Even with that uncertainty, however, CBO's analysis indicates that the Navy's plan will cost substantially more on an annual

basis than the service has spent on battle force ships since the end of the Cold War.

The Navy's Estimate of the Costs of the 2006 Shipbuilding Plan

In its February report to the Congress, the Navy stated that building all of the ships it requires over the next three decades would cost an average of \$13.4 billion per year in 2005 dollars—or \$14.4 billion in 2007 dollars—for new-ship construction alone. Refuelings of nuclear-powered vessels would add about \$1 billion annually to that amount. The resulting figure of about \$15.5 billion per year for new-ship construction and nuclear refuelings is about 30 percent higher than what the Navy spent on those two areas between 2000 and 2005. Moreover, the Navy did not indicate how much mission modules for the littoral combat ship or modernizations of existing surface combatants could add to that total cost.

The Navy assumed that its total obligational authority—the budgetary top line—would increase at the same rate of inflation as DoD programs overall. In other words, the Navy assumed no real growth in its budget for the next 30 years. To be able to devote a higher proportion of that budget to shipbuilding than it has recently, the Navy made three key assumptions:

- That spending on operations and maintenance in the Navy's accounts would grow only at the rate of inflation;
- That spending on research and development—which hit a historical high of about \$19 billion in 2006—would fall by \$4 billion or \$5 billion and remain at that level through the next 30 years; and
- That any increase in pay and benefits for Navy personnel beyond the general rate of inflation would be offset by reductions in the number of personnel (the Navy's end strength).

In addition, senior Navy leaders have stated that to pay for all of the ships in the current plan, they would have to meet strict cost goals for major types of ships. In some cases, those targets would require the Navy to reduce the costs of major classes of ships already in production; in other cases, they would allow little or no growth in the costs of prospective ships relative to the costs of the ships they would replace.

Specifically, to build two submarines a year starting in 2012, the cost per vessel would have to fall from about \$2.6 billion today to \$2.1 billion, the Navy says.³² The cost goal for next-generation ballistic missile submarines is \$3.0 billion each, which is just 11 percent more than Virginia class attack submarines cost today, even though ballistic missile submarines are typically much larger than attack submarines. (The current Ohio class SSBNs, for example, are more than twice as large as Virginias.) The goal for new surface combatants—in particular, the replacement for the Arleigh Burke class destroyer—is a cost of no more than \$1.9 billion apiece.³³ And the target for amphibious ships is an average cost of no more than \$1.4 billion each, compared with \$1.4 billion to \$2.6 billion for amphibious ships being built today.

The one exception to the Navy's strict targets is the cost goal for CVN-21 class aircraft carriers: an average of \$9.4 billion apiece. In comparison, the Navy expects the first CVN-21 to cost \$8.1 billion, excluding about \$2.4 billion for the sort of nonrecurring detail design that is usually associated with the first ship of a new class.

The Navy plans to pursue aggressive cost-cutting efforts to reduce the price tags of ships now being designed or built, including the Zumwalt class destroyer and the Virginia class attack submarine—both of which, the Navy is projecting, will cost more than their goals for at least the next five years. For ships that would be built later, the Navy derived its cost targets by fixing the proportion of the shipbuilding budget that could be devoted to a particular category of ships. Thus, those targets are not based on a specific design, size, or set of capabilities.

CBO's Estimate of the Costs and Implications of the Navy's Plan

The 2006 shipbuilding plan envisions that the Navy will buy a total of 275 ships over the 2006-2035 period—an average of about nine per year. CBO estimates that those purchases would require an average annual shipbuilding budget of about \$19.5 billion, compared with the Navy's

estimate of a little more than \$14.4 billion. With refuelings of nuclear-powered aircraft carriers and submarines, mission modules for littoral combat ships, and modernization of cruisers and destroyers included, the Navy's ship procurement costs under the 2006 plan would average \$21.6 billion per year through 2035, CBO estimates. (For more details about how CBO estimated construction costs for ships and aircraft, see Box 2-1.)

The size of the battle force fleet would initially rise under the Navy's plan as the first 55 littoral combat ships entered the inventory over the next 20 years. The fleet would peak at 330 ships in 2019 and then gradually decline to 294 by 2035 (see Figure 2-1 on page 14).

The Navy would experience a lull in annual ship purchases between 2017 and 2021 under the current plan. That procurement lull would result directly from buying and deploying large numbers of LCSs through 2016 and then not needing to purchase many ships until 2022. By the early 2020s, however, the Navy would have to begin buying replacements for Arleigh Burke class destroyers that reached the end of their nominal 35-year service life. In addition, as noted earlier, various support and amphibious ships would need to be replaced in the 2020s. By the 2030s, LCSs would also need replacing.

The 2006 shipbuilding plan would not meet all of the Navy's stated requirements for two important categories of ships: submarines and large surface combatants. The 313-ship requirement includes 48 attack submarines, four guided missile submarines, and 88 cruisers and destroyers. Under the shipbuilding plan, however, the Navy would increase its construction of attack submarines to two per year in 2012 and continue that rate through 2028, after which it would build two SSNs every even year and one every odd year. That rate would cause the number of attack and guided missile submarines to fall below 52 beginning in 2020 (see Figure 2-2). Moreover, under the Navy's plan, the four guided missile submarines would not be replaced when they reached the end of their service life in the 2020s.

Similarly, the 2006 shipbuilding plan would begin replacing Arleigh Burke class destroyers in 2023 at a rate of two per year. As a result, the cruiser and destroyer force would fall below the 88-ship requirement starting in 2028 and would not recover within the 30-year time frame of the

32. In a briefing to CBO and the Congressional Research Service, the Navy presented its cost goals in 2005 dollars. For the purposes of this analysis, CBO inflated them to 2007 dollars.

33. Procuring a new Arleigh Burke class destroyer today would cost \$1.8 billion (in 2007 dollars) at a rate of one per year or \$1.4 billion each at a rate of two per year.

Box 2-1.**Developing Cost Estimates for Navy Ships and Aircraft**

To estimate the costs of ships that are already under construction, the Congressional Budget Office (CBO) relied on the Navy's cost estimates, adjusted for the real (inflation-adjusted) growth that the naval shipbuilding industry has been experiencing (see Box 2-2 on page 29). For ships not yet under construction, CBO relied mainly on a cost-per-thousand-tons methodology, using current or historical analogies for future ship programs. For example, in developing an estimate for the lead Zumwalt class destroyer, CG(X) cruiser, and DDG(X) destroyer, CBO used the lead Arleigh Burke (DDG-51) class destroyer and Ticonderoga (CG-47) class cruiser as analogies. CBO assumed that the first ship of each new class would have about the same cost per thousand tons as the DDG-51 or CG-47, adjusted for inflation. CBO estimated the cost of succeeding ships in those new classes on the basis of past patterns in how the cost per ship declines as more are built. That cost is based on lightship displacement for ships or Condition A displacement for submarines (the weight of the vessels themselves without their crew, materiel, weapons, and fuel).

The one exception to that approach for future ships involved the CVN-21 class of aircraft carriers now being designed. Relying on historical relationships between cost and weight for aircraft carriers would result in a cost estimate for the first ship of that class that was less than the Navy's estimate. Instead, as it did with ships under construction, CBO used the Navy's estimate for the CVN-21 in this analysis, adjusting that estimate for real growth in naval shipbuilding costs.

To estimate the costs of Navy aircraft programs, CBO generally relied on the Navy's estimates as presented in the Selected Acquisition Reports sent to the Congress each year. However, those estimates exclude potential cost growth that similar aircraft programs have experienced in the past. If such cost growth were included, the alternative modernization plans examined in this analysis would either cost more or involve the purchase of fewer ships and aircraft.

Navy's report. By 2035, that force would number 73 ships.³⁴

Fully funding the 313-ship requirement so that the number of attack submarines and large surface combatants did not fall substantially below what the Navy says it needs would cost an average of \$21.7 billion per year for new-ship construction, CBO estimates. The average annual cost would rise to \$23.8 billion with nuclear refuelings, LCS mission modules, and surface combatant modernizations included.³⁵

34. If the construction rate of two surface combatants per year was maintained indefinitely, the Navy would eventually achieve a steady-state level of 70 destroyers and cruisers, compared with a total requirement of 88.

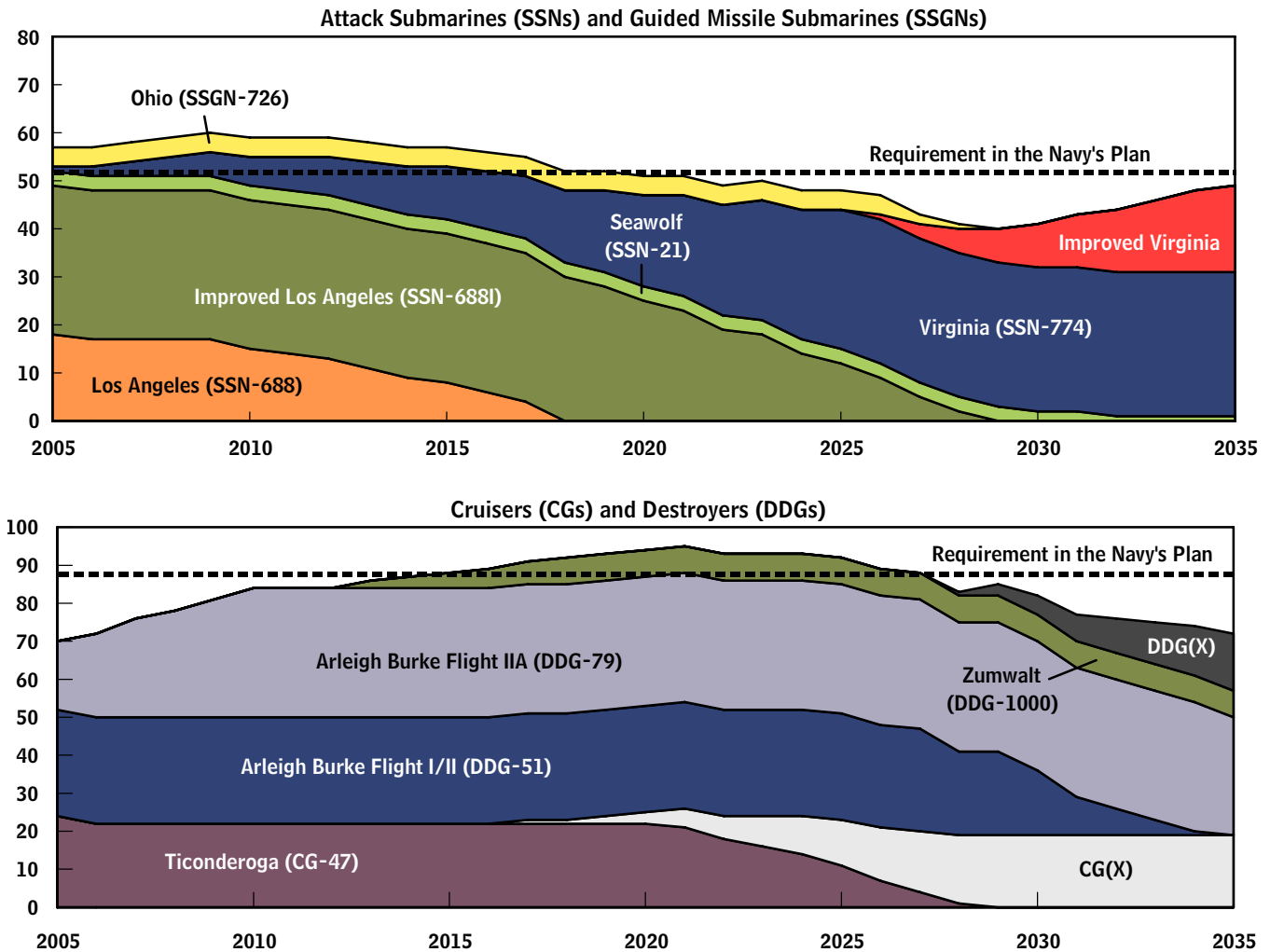
35. CBO's estimates include outfitting and postdelivery costs. It is not clear whether the Navy's cost targets include those items.

Overall, CBO estimates that the Navy's shipbuilding programs would cost \$665 billion over 30 years, compared with a total of \$466 billion under the Navy's assumptions and cost goals. The difference of about \$200 billion is accounted for as follows:

- 30 percent by large surface combatants,
- 24 percent by ballistic missile submarines,
- 23 percent by attack submarines,
- 8 percent by amphibious or MPF(F) ships,
- 8 percent by aircraft carriers,
- 3 percent by littoral combat ships, and
- 2 percent by support ships.

Figure 2-2.

Inventory of Submarines, Cruisers, and Destroyers Under the Navy's 2006 Shipbuilding Plan



Source: Congressional Budget Office.

Assumptions About Inflation in Shipbuilding

CBO's estimate of the costs of the Navy's shipbuilding programs includes some specific assumptions about price increases in the ship construction industry. An analysis that the Navy provided to CBO indicates that over the next five years, annual inflation is expected to be about 1.3 percentage points higher, on average, for that industry than for DoD's procurement programs overall. Likewise, for the past 10 years, actual price increases for naval ships have been about 1.7 percent higher per year than for overall DoD procurement.

CBO's estimates incorporate that real price growth experienced by naval shipbuilding. CBO assumed that increases in ship construction costs would continue to outpace increases in DoD's overall procurement costs for the next 20 years. As a result, a ship that cost \$2.5 billion to build in 2007 would cost \$3.0 billion (in 2007 dollars) to build in 2020. After 20 years, shipbuilding inflation was assumed to subside to the overall level of DoD procurement inflation. (For more details, see Box 2-2.)

Box 2-2.**The Treatment of Inflation in Estimating Future Shipbuilding Costs**

The Department of Defense (DoD) Comptroller publishes annual forecasts of price increases for each of the major defense appropriation accounts: military personnel, operations and maintenance, procurement, and so on. The military services use those inflation forecasts (known as “inflaters”) to estimate their funding requirements for the upcoming budget year and the five subsequent years spanned by the Future Years Defense Program.

Within the Department of the Navy, the Naval Sea Systems Command (NAVSEA) manages ship procurement. NAVSEA has argued that prices for the labor and materials used in ship construction increase at faster rates than the DoD Comptroller’s procurement inflator. NAVSEA has documented such excess inflation for the past 10 years and expects it to continue in the future. Excess inflation is especially problematic for ship construction because a nuclear-powered submarine or aircraft carrier may take as long as seven years to build. Excess inflation compounds over that period, so the costs in the final year of construction may be considerably higher than would be forecast using the standard procurement inflator.

To avoid underfunding future ship construction, NAVSEA has received permission from the DoD Comptroller to incorporate more-rapid inflation into its plans than the standard procurement inflator would imply. NAVSEA has developed specific inflation forecasts for each of the six major commercial shipyards that build naval vessels. Those forecasts reflect the increases in overhead rates that each shipyard has negotiated with NAVSEA as well as the pay raises that each shipyard has negotiated with its local labor unions. NAVSEA has not provided those shipyard-specific inflation forecasts to the Congressional Budget Office (CBO). However, the forecasts are not necessarily appropriate for CBO’s analysis, because most ship classes can be built by more than one shipyard.

Instead, for the cost estimates in this analysis, CBO applied a weighted-average inflation forecast that reflects overall inflation in the shipbuilding industry. That weighted-average forecast exceeds DoD’s standard procurement inflator by varying amounts in each year through 2025. On average, it is 1.3 percentage points higher per year than DoD’s standard inflator through 2020, then declines to equal the standard inflator by 2025. Those increases compound to make ship construction costs about 22 percent higher by 2025 than DoD’s standard inflator would predict.

Beyond 2025, CBO assumes that excess inflation will disappear and that shipbuilding costs will rise at the same rate as DoD’s overall procurement account. In the absence of that assumption, the Navy’s ship construction account would make up an ever-increasing and implausibly large share of the Navy’s total budget and of DoD’s overall procurement account. CBO’s assumption gives the Navy almost 20 years to develop contractual, industrial, technological, or other mechanisms to control the growth of shipbuilding costs.

CBO estimated the annual costs of ship construction through 2035 in constant (2007) dollars, deflated by the DoD Comptroller’s procurement inflation index. Thus, those estimates incorporate the real growth that naval ship programs have been experiencing. For ship classes that are procured in fairly constant annual amounts, costs tend to increase over time because ship construction costs rise more rapidly than the DoD index that is used to deflate them to constant dollars. (A mitigating factor is that annual costs may tend to decline throughout the life of a ship class because of learning-curve effects: shipyards may improve their production techniques or negotiate more-favorable contracts with suppliers as they build successive ships of the same class.) CBO also computed average annual construction costs for the years over which each class of ship is assumed to be procured (truncated, if necessary, at the end of the analysis period in 2035). Those average construction costs embody the assumption of real cost growth over the duration of each procurement program.

Shortfall in Ship Construction Relative to Steady-State Levels

Using the Navy's ship inflation index, CBO calculated that the service spent an average of \$10 billion annually between 1993 and 2005 to purchase an average of 5.8 ships per year.³⁶ Those amounts were far below the levels that would be needed to indefinitely sustain a fleet of 313 battle force ships. Keeping the fleet at that size over 35 years (the average service life of the fleet) would require buying ships at a rate of 9.2 per year. Based on the prices of ships now or expected soon to be under construction, those purchases would require an average shipbuilding budget of \$19.5 billion per year.

If, instead, ship procurement funding continued at the level it averaged between 2000 and 2005—\$11.7 billion annually—the Navy would have purchased enough ships by 2028 (the end of the 35-year period that began in 1993) to sustain a fleet of about 175 ships. Thus, it would have a cumulative 35-year shortfall of 138 ships relative to the 313-ship requirement.³⁷

Total Procurement and Operating Costs for Navy Ships and Aircraft

Besides ship construction costs, which are the focus of this study, CBO estimated the amount of money necessary to carry out the Navy's aircraft programs and to operate its planned fleets of ships and aircraft.

Today, direct operation and support (O&S) costs for the Navy's battle force ships total about \$14 billion per year, CBO estimated using information in the Navy's Visibility and Management of Operating and Support Costs

(VAMOSOC) database.³⁸ Under the 2006 shipbuilding plan, annual direct O&S costs would decline to \$13.1 billion by 2035. That reduction would occur because ships that were less expensive to operate would substitute for ships with higher operating costs. For example, the littoral combat ship, which would be introduced in large numbers under the Navy's plan, is likely to be cheaper to operate than other, larger classes of ships whose numbers would be cut under the plan, such as amphibious ships or submarines. In addition, new classes of ship such as the Zumwalt, CG(X), and CVN-21 are intended to have smaller crew sizes, and thus lower operating costs, than their predecessors. Over the entire 2006-2035 period, direct O&S costs for the battle force fleet would average \$14.3 billion per year.

Procuring the aircraft implied by the 2006 plan would cost about \$7.5 billion annually, on average, and operating and maintaining naval aircraft would cost another \$9.2 billion a year, CBO estimates.³⁹ As it did with ships, CBO relied on data from the VAMOSOC database to calculate direct O&S costs for the aircraft covered by this analysis.

In all, then, ship and aircraft purchases and operation and support costs under the Navy's plan would average about \$53 billion per year between 2006 and 2035, CBO estimates. By comparison, the Navy spent a total average of about \$43 billion annually on those cost categories from 2000 to 2005 (see Figure 2-3).

36. CBO chose the date of 1993 because it marked the beginning of the post-Cold War era of relatively low shipbuilding.

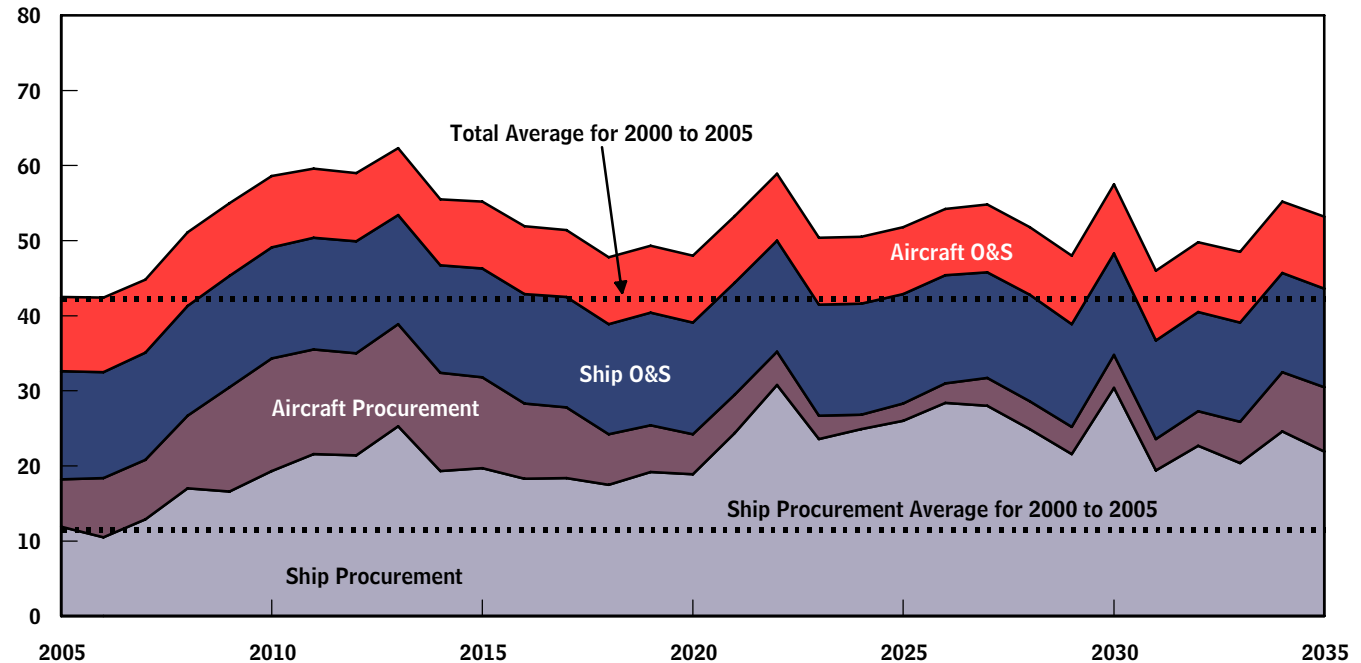
37. The cumulative shortfall from 1993 to the present is about 40 ships relative to the 313-ship force.

38. Direct operation and support costs are those directly related to the number of ships or aircraft in the fleet, such as costs for fuel, supplies, and compensation of personnel.

39. The procurement estimate excludes several of the Navy's cost categories: modifications of aircraft, spares and repair parts, and aircraft support equipment and facilities.

Figure 2-3.**Ship and Aircraft Costs Under the Navy's 2006 Shipbuilding Plan**

(Billions of 2007 dollars)



Source: Congressional Budget Office.

Notes: O&S = direct operation and support costs (those directly related to the number of ships or aircraft in the fleet, such as costs for fuel, supplies, and compensation of personnel).

Procurement costs for 2006 exclude supplemental funding related to Hurricane Katrina.

Lower-Cost Alternatives to the Navy's Modernization Plan

As Chapter 2 described, the Navy has set strict cost goals for itself to execute its 2006 plan for shipbuilding. Nevertheless, the Congressional Budget Office estimates that the Navy would need a substantial funding increase to carry out its current plan. To illustrate ways in which the Navy could modernize its fleet of ships and aircraft without an increase in funding (other than for inflation), CBO constructed five alternative approaches that would cost roughly the same amount as the Navy spent on procurement and operations and support from 2000 to 2005—about \$43 billion per year (in 2007 dollars).¹ All of the alternatives would result in a smaller Navy than exists today (see Table 3-1). In several instances, however, those smaller fleets would be more capable than the current force by some measures.

The first approach would reduce the Navy's various ship programs by roughly equal percentages to meet the budgetary constraints assumed in this analysis. The other four options would each emphasize a different area of

naval warfare—surface combatants, submarines, aircraft carriers, or amphibious warfare and maritime prepositioning forces—at the expense of others. Those options illustrate the trade-offs that would have to be made if the Navy favored one category of ship at the expense of all others. CBO chose the alternatives to show the potential impact on different components of the fleet if large and sustained increases in funding for ship construction do not occur.

This chapter describes in detail the different force structures associated with the five options. The next chapter uses various measures of capability to compare those alternatives with the Navy's 2006 shipbuilding plan and with the current fleet.

Because this analysis is structured around potential resource constraints, CBO developed the options by focusing on planned ship programs rather than on different scenarios for the future security environment. However, this chapter discusses qualitatively how suited the alternatives would be to coping with the potential future threats described in Chapter 1.

CBO made several assumptions for all of the options in this analysis:

1. The five options are about equally costly (given the constraints of having to purchase whole numbers of ships and aircraft) after accounting for the fact that shipbuilding costs are expected to grow 1.3 percentage points faster per year, on average, than defense procurement programs overall for the next two decades. An alternative presentation would account not only for the real growth in shipbuilding costs but also for the time value of money—for example, by discounting future costs along the lines suggested in the Office of Management and Budget's Circular A-94. However, the five options would still have roughly equal costs even if their costs were discounted and expressed as a single present value. The reason is that all of the options would procure ships on a relatively smooth schedule throughout the 30-year period of the analysis. Discounting would make a substantial difference only if some of the options were front-loaded (buying most of the ships in the early years) and others were back-loaded (buying most of the ships in the later years). In that case, discounting would favor the back-loaded options, allowing them to buy additional ships while maintaining a roughly equal present value.

- Very few ships would be retired before the end of their notional service life. (That assumption is at odds with past practice. Historically, the Navy has tended to retire ships, especially surface combatants, before the end of their service life, mainly for budgetary reasons.)
- Arleigh Burke class destroyers would be modernized to ensure a service life of 35 years. (Thus, when an option reduces the number of DDG-51s, it does so by not purchasing replacements rather than by retiring Arleigh Burkes before they reach the 35-year mark.)

Table 3-1.**The Alternative Force Structures Examined in CBO's Analysis**

						Memorandum:	
						Current Fleet ^a	Navy's 313-Ship Requirement
Option 1	Option 2	Option 3	Option 4	Option 5			
For an Equal Amount of Annual Funding (\$43 billion in 2007 dollars ^b), the Navy Could Have One of the Following:							
	The same mix of capabilities as currently planned but fewer ships	The new types of destroyers, cruisers, and littoral combat ships now planned	55 attack submarines over the long term	11 aircraft carriers and 10 air wings over the long term	A robust capability to support onshore operations from the sea (sea basing)	n.a.	c
With This Steady-State Battle Force Fleet: ^d							
Aircraft Carriers	7	7	8	11	7	12	11
Surface Combatants							
DDG-51s/DDG(X)s	38	28	31	38	38	49	62
DDG-1000s	5	7	0	0	0	0	7
CGs/CG(X)s	11	19	0	8	0	23	19
FFGs	0	0	0	0	0	30	0
LCSs	40	82	55	40	55	0	55
LPD-17 fire-support ships	0	0	0	0	7	n.a.	n.a.
Submarines							
SSNs	35	30	55	30	30	53	48
SSBNs	10	10	10	10	10	14	14
SSGNs	0	0	4	0	0	4	4
Amphibious Ships							
LHDs/LHA-6s	7	6	6	6	9	11	9
LPD-4s/LPD-17s	8	7	7	7	10	12	10
LSDs/LSD(X)s	0	0	0	0	9	12	12
MPF(F) Ships (Squadrons)	12 (1)	0	0	0	24 (2)	0	12 (1)
Combat Logistics Force	25	27	21	21	26	32	30
Support Ships	13	10	10	10	16	33	20
Total	211	233	207	181	241	285	313

Continued

Table 3-1.**Continued**

	Option 1	Option 2	Option 3	Option 4	Option 5	Memorandum:	
						Current Fleet ^a	Navy's 313-Ship Requirement
Strike Groups							
Carrier strike groups	7	7	8	11	7	12	11
Expeditionary strike groups	7	6	6	6	9	11	9
Surface action groups	4	5	0	0	0	9	9
SSGN strike forces	0	0	4	0	0	4	4
Total	18	18	18	17	16	36	33

Source: Congressional Budget Office.

Note: n.a. = not applicable; DDG-51 = Arleigh Burke class destroyer; DDG(X) = future replacement for Arleigh Burke class destroyers; DDG-1000 = Zumwalt class destroyer (formerly the DD(X)); CG = guided missile cruiser; CG(X) = future guided missile cruiser; FFG = guided missile frigate; LCS = littoral combat ship; LPD-17 = San Antonio class amphibious transport dock; SSN = attack submarine; SSBN = ballistic missile submarine; SSGN = guided missile submarine; MPF(F) = Maritime Prepositioning Force (Future).

- a. At the beginning of 2006.
- b. \$43 billion is the average yearly amount that the Navy spent on procurement and operations and support for ships and aircraft between 2000 and 2005.
- c. The Navy's shipbuilding plan would require average annual funding of about \$53 billion over the next 30 years, CBO estimates.
- d. The steady-state battle force fleet is the fleet that could be sustained in the long term (beyond 2035) if the funding level and procurement approaches of the various options were continued indefinitely.

- The Navy would employ a rotational crewing concept for all of its destroyers and new cruisers by 2012. (The Navy's current plan is to use rotational crewing only on its future DDG-1000 Zumwalt destroyers and littoral combat ships, in addition to maintaining the long-standing dual-crew system for ballistic missile submarines.)²
- The Navy would continue to base a carrier strike group and an expeditionary strike group in Japan through 2035.
- Nine attack submarines would be based in Guam by 2012. (The Navy currently has three submarines in Guam and is not planning to increase that number.)³
- The Navy would retain the Fleet Response Plan, which is intended to improve crisis response by keeping certain ships in a higher average state of readiness.
- The size and composition of the Marine Corps's air and ground units would remain unchanged.
- Each option would buy 10 new ballistic missile submarines rather than the Navy's requirement of 14 to save money. In all but the submarine alternative (Option 3), design of those SSBN(X)s would begin in 2007 to sustain the submarine-design industrial base.⁴ The first SSBN(X) would be purchased by 2015, seven years earlier than in the Navy's plan. Option 3 would begin designing a replacement guided missile submarine, the SSGN(X), around 2007 for acquisition in 2017. Production of the SSBN(X) would start in 2022.

2. In recent legislation, however, the House of Representatives expressed concern about the Navy's Sea Swap crew-rotation program and proposed halting further experimentation with or implementation of crew rotation for the next two years.

3. Recently, a senior submarine admiral downplayed the idea of basing more than three submarines in Guam. See Richard R. Burgess, "Interview: Vice Admiral Charles L. Munns, Commander, Naval Submarine Forces," *Seapower* (February 2006), pp. 20-23.

4. Christopher Cavas, "Electric Boat to Lay Off up to 2,400 Workers," *Defense News* (December 6, 2005); and Robert A. Hamilton, "Flagging Submarine Design System Called Dangerous Problem for U.S.," *The Day* (New London, Conn.), June 14, 2005.

These alternatives focus primarily on issues related to shipbuilding. However, they do consider trade-offs between naval aviation and ships. Four of the five options would reduce the number of carrier strike groups—and thus the number of carrier air wings—so any savings from buying and operating fewer aircraft would be used to build additional ships.

Option 1: Reduce Ship Programs Across the Board

To illustrate the effects of an across-the-board cut in the Navy's planned battle force fleet, the first alternative would reduce all of the major components of the fleet by about 30 percent to 40 percent by 2035 from the numbers in the 313-ship requirement. (The only exceptions are guided missile submarines, which would not be replaced under the Navy's current plan, and the future maritime prepositioning force, which is not comparable, in terms of capability, to anything in today's fleet.) No new class of ships would be canceled, and the Navy would buy all of the new weapons and technologies that it considers essential to the future force. To the extent that the Navy views the 313-ship fleet as transformational, this option would follow the same path of transformation, but with reduced quantities.

Recent history offers a precedent for reductions spread in roughly equal proportion across all elements of the Navy's fleet. Since 1990, the Navy has cut the number of battle force ships from 574 to 285. However, the composition of the fleet has remained relatively constant, with no one category of ship varying by more than 3 percentage points in its contribution to the total fleet (see Table 1-1 on page 2).⁵

Specifically, Option 1 would eventually reduce the number of aircraft carriers from the Navy's planned 11 to seven. The number of expeditionary strike groups would also decline to seven from the nine in the 313-ship requirement. The number of amphibious ships in those strike groups would fall by half, but CBO assumed for this option that the ships of the future maritime prepositioning force would probably operate with the expeditionary strike groups to some extent once they were deployed overseas. The ballistic missile submarine force

would decline from 14 to 10 and the attack submarine force from the planned 48 to 35.

With respect to surface combatants, the number of Arleigh Burke class destroyers would be reduced by nearly 40 percent. Their replacements would be bought starting in 2026. Total purchases of Zumwalt class destroyers, CG(X) cruisers, and Freedom class littoral combat ships would be about 30 percent smaller than those implied by the 313-ship requirement.

Ship Procurement Under Option 1

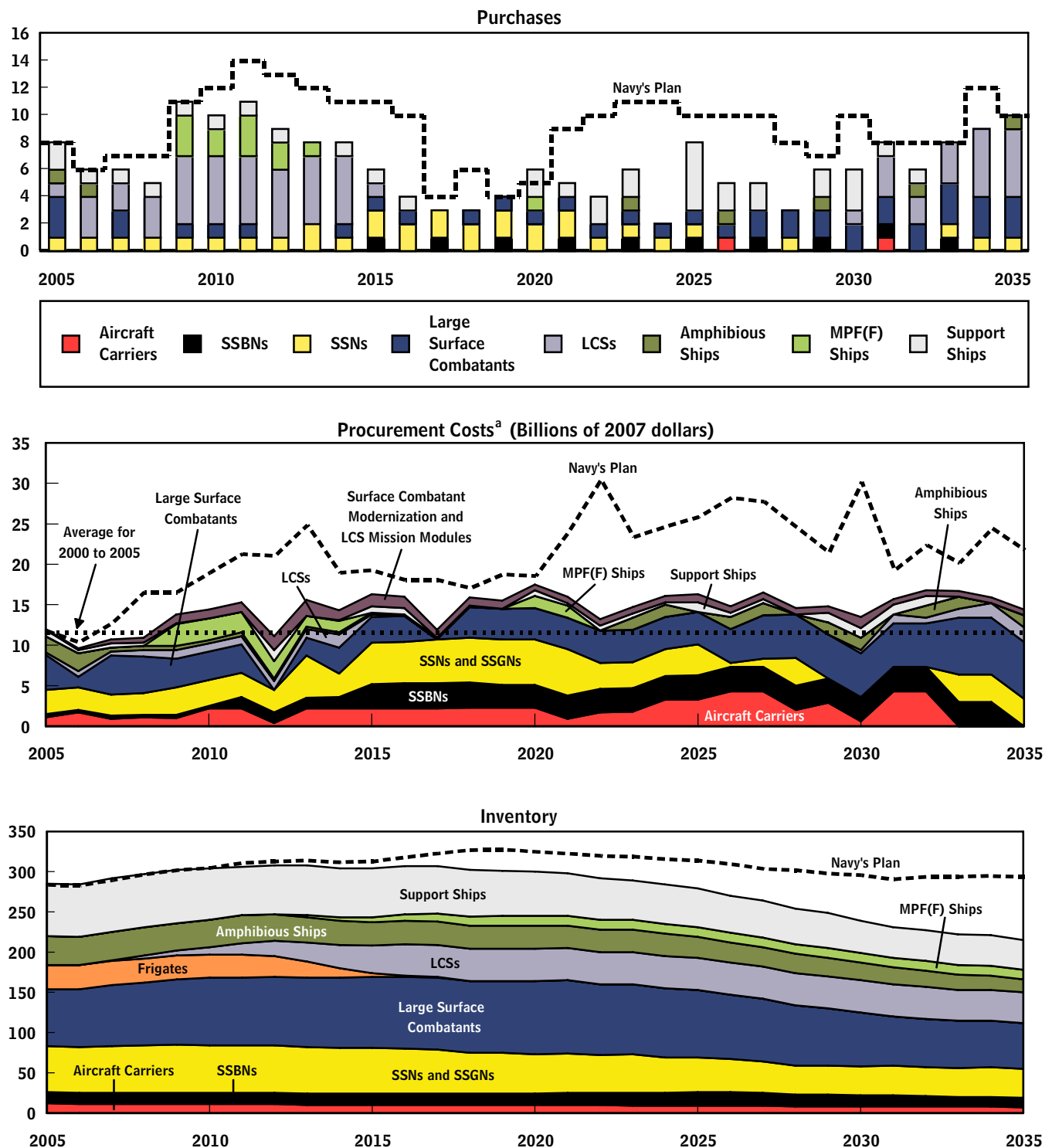
The most useful way to compare different amounts of shipbuilding is in terms of both numbers of ships and their weight (measured by lightship displacement, known as Condition A displacement for submarines).⁶ The number of ships being purchased on an average annual basis reveals what size fleet can be sustained over time. The average amount of displacement being purchased per year shows the relative workload for the shipyards that construct naval vessels. (For a brief analysis of how shipyards' workload might change under the options in this analysis, see the appendix.)

Overall, Option 1 would procure an average of 6.4 battle force ships a year between 2006 and 2035, compared with 9.2 under the Navy's 2006 shipbuilding plan. In terms of lightship or Condition A displacement, this option would build an average of 61,000 tons per year. Surface combatants would make up one-third of the ships constructed (an average of 3.2 per year, of which 1.9 would be LCSs) and more than one-quarter of the tonnage (17,000 tons per year, on average). Amphibious and MPF(F) ships would be purchased at a rate of 0.6 (18,000 tons) per year, aircraft carriers at 0.1 (5,200 tons) per year, and attack submarines at 1.1 (6,900 tons) annually. Under the 2006 plan, by comparison, the Navy would buy 4.2 surface combatants (including 2.5 LCSs), 1.1 amphibious and MPF(F) ships, 0.2 aircraft carriers, and 1.7 attack submarines per year.

To achieve those reductions, Option 1 would not retire Nimitz class aircraft carriers early but rather reduce procurement of the new CVN-21 class. Only two CVN-21s would be purchased by 2035 (see Figure 3-1). The number of Arleigh Burke destroyers would be reduced from the 62 ordered so far to 38—again, not by retiring any of

5. See Christopher Cavas, "USN Fleet Plan Faces Outyear Challenge," *Defense News* (January 30, 2006), p. 6.

6. Lightship or Condition A displacement refers to the weight of a vessel itself without its crew, materiel, weapons, or fuel.

Figure 3-1.**Purchases, Costs, and Inventory of Battle Force Ships Under Option 1**

Source: Congressional Budget Office.

Note: SSBNs = ballistic missile submarines; SSNs = attack submarines; SSGNs = guided missile submarines; LCSs = littoral combat ships; MPF(F) = Maritime Prepositioning Force (Future).

a. Data for 2006 exclude supplemental funding related to Hurricane Katrina.

them early but by not purchasing as many replacements as would be needed to sustain a larger force during the 2020s and 2030s. The Zumwalt destroyer and CG(X) programs would be reduced to five and 11 ships, respectively. The number of LCSs would be limited to 40.

In terms of amphibious ships, this option would decrease the number of large, flat-deck amphibious assault ships to seven, thus permitting replacements for the LHDs to be delayed until 2023. The LPD-17 program would be capped at eight ships. No replacements for the LSDs currently in the fleet would be purchased. The number of maritime prepositioning squadrons would be reduced to two, only one of which would be designed for sea basing. Under this option, future expeditionary strike groups would consist of one LHD or LHA-6 and one LPD-17, along with three surface combatants and an attack submarine. Once overseas, they could join up with some ships from the sea-basing-capable MPF(F) squadron for the duration of their deployment.

Under this option, the total number of battle force ships would initially rise from 285 today to 299 by 2020, close to the Navy's requirement. In 2020, the fleet would include:

- 10 aircraft carriers,
- 14 ballistic missile submarines,
- 45 attack submarines,
- 4 guided missile submarines,
- 91 large surface combatants,
- 40 littoral combat ships,
- 28 amphibious ships, and
- 12 sea-basing-capable maritime prepositioning ships.

By 2035, however, the size of the fleet would fall to 217 battle force ships under this option (see Table 3-2). Each major category of ship would remain at relatively high levels through 2015 but would decline gradually thereafter as fewer ships were purchased to replace vessels that reached their retirement age. In 2035, the fleet would include:

- 7 aircraft carriers,
- 12 ballistic missile submarines,
- 36 attack submarines,
- 57 large surface combatants,
- 40 littoral combat ships,
- 15 amphibious ships, and
- 12 sea-basing-capable maritime prepositioning ships.

Aircraft Procurement Under Option 1

Compared with the Navy's current plan, this alternative would reduce the number of deployable carrier air wings from 10 to six and eliminate the nondeployable reserve wing. (The number of air wings is generally one less than the number of aircraft carriers because, at any point, one carrier is usually laid up in long-term maintenance.) No other changes to the Navy's long-term plans for aviation would be made.

As a result of the reduction in air wings, the Navy would buy 150 fewer Joint Strike Fighters, 20 fewer F/A-18G Growlers, 28 fewer E-2Cs, 117 fewer MH-60R and MH-60S helicopters, and 28 fewer unmanned combat air vehicles (UCAVs). Overall, those reductions would save almost \$14 billion between 2006 and 2035 (most of it during the 2010s)—or an average of about \$500 million per year—compared with the Navy's plan.

Costs of Option 1

Under this alternative, the Navy would spend an average of \$14.5 billion annually on ship construction and \$7.0 billion on aircraft procurement through 2035 (see Table 3-3). Those costs are much lower than under the Navy's current plan, which would spend an average of \$21.6 billion to build ships and \$7.5 billion to build aircraft between 2006 and 2035. (As another point of comparison, if the ships in Option 1 were bought at a steady-state rate—the number of ships in the force divided by their service life—the Navy would require about \$14.3 billion per year in shipbuilding funds.)

Operation and support costs for the battle force fleet would average about \$12.8 billion annually over the next 30 years under this option but would fall to \$9.2 billion by 2035 (see Figure 3-2). Operating and supporting

Table 3-2.

Composition of the Battle Force Fleets in 2020 and 2035 Under Alternative Force Structures

	Navy's 2006 Shipbuilding Plan	Option 1 (Across-the- board cuts)	Option 2 (Surface combatants)	Option 3 (Submarines)	Option 4 (Aircraft carriers)	Option 5 (Sea basing)
Battle Force Ships in 2020						
Aircraft Carriers	12	10	10	10	11	10
Surface Combatants						
DDG-51s/DDG(X)s	62	62	62	62	62	64
DDG-1000s	7	5	7	0	0	0
CGs/CG(X)s	25	24	24	22	26	22
Littoral combat ships	55	40	57	55	40	55
LPD-17 fire-support ships	0	0	0	0	0	7
Submarines						
SSNs	47	45	44	52	44	44
SSBNs	14	14	14	14	14	14
SSGNs	4	4	4	4	4	4
Amphibious Ships	31	28	28	28	28	32
MPF(F) Ships	11	12	0	0	0	13
Logistics and Support Ships	58	55	50	49	49	58
Total	326	299	300	296	278	323
Battle Force Ships in 2035						
Aircraft Carriers	12	7	7	8	11	7
Surface Combatants						
DDG-51s/DDG(X)s	47	41	38	44	44	49
DDG-1000s	7	5	7	0	0	0
CGs/CG(X)s	19	11	19	0	8	0
Littoral combat ships	55	40	82	55	40	55
LPD-17 fire-support ships	0	0	0	0	0	7
Submarines						
SSNs	49	36	31	54	30	30
SSBNs	12	12	12	10	12	12
SSGNs	0	0	0	4	0	0
Amphibious Ships	30	15	13	13	13	28
MPF(F) Ships	12	12	0	0	0	24
Logistics and Support Ships	51	38	37	31	31	43
Total	294	217	246	219	189	255

Source: Congressional Budget Office.

Note: DDG-51 = Arleigh Burke class destroyer; DDG(X) = future replacement for Arleigh Burke class destroyers; DDG-1000 = Zumwalt class destroyer (formerly the DD(X)); CG = guided missile cruiser; CG(X) = future guided missile cruiser; LPD-17 = San Antonio class amphibious transport dock; SSN = attack submarine; SSBN = ballistic missile submarine; SSGN = guided missile submarine; MPF(F) = Maritime Prepositioning Force (Future).

Table 3-3.

Average Annual Spending for Ships and Aircraft Under Alternative Force Structures

(Billions of 2007 dollars)

		2006-2035					
	2000-2005	Navy's 2006 Shipbuilding Plan	Option 1 (Across-the-board cuts)	Option 2 (Surface combatants)	Option 3 (Submarines)	Option 4 (Aircraft carriers)	Option 5 (Sea basing)
Ships							
Procurement	11.7	21.6	14.5	14.6	14.5	13.2	14.3
Operation and support	14.7	14.3	12.8	12.8	12.5	12.6	13.2
Aircraft							
Procurement ^a	6.1	7.5	7.0	7.0	7.1	7.5	7.0
Operation and support	10.0	9.2	8.2	8.2	8.4	9.2	8.2
Total	42.5	52.5	42.5	42.6	42.5	42.5	42.6

Source: Congressional Budget Office.

Note: The operation and support costs shown here are those directly related to the number of ships or aircraft in the fleet (such as costs for fuel, supplies, and compensation of personnel).

a. Excludes modifications of aircraft, spares and repair parts, and aircraft support equipment and facilities.

naval aircraft would cost an additional \$8.2 billion per year, on average. Under the Navy's plan, by comparison, O&S costs would average \$14.3 billion for ships and \$9.2 billion for aircraft.

In all, the Navy's ship and aircraft costs would average \$42.5 billion per year between 2006 and 2035 under Option 1. As stated above, that figure is equal to average spending over the past six years.

Steady-State Composition of the Fleet Under Option 1

Eventually, this alternative would result in a steady-state fleet of 211 battle force ships, about 25 percent smaller than the current fleet. The number of strike groups would also decline substantially under this option: to seven carrier strike groups, seven expeditionary strike groups, and four surface action groups. Those 18 strike groups represent just half the number envisioned in the Navy's Global Concept of Operations.

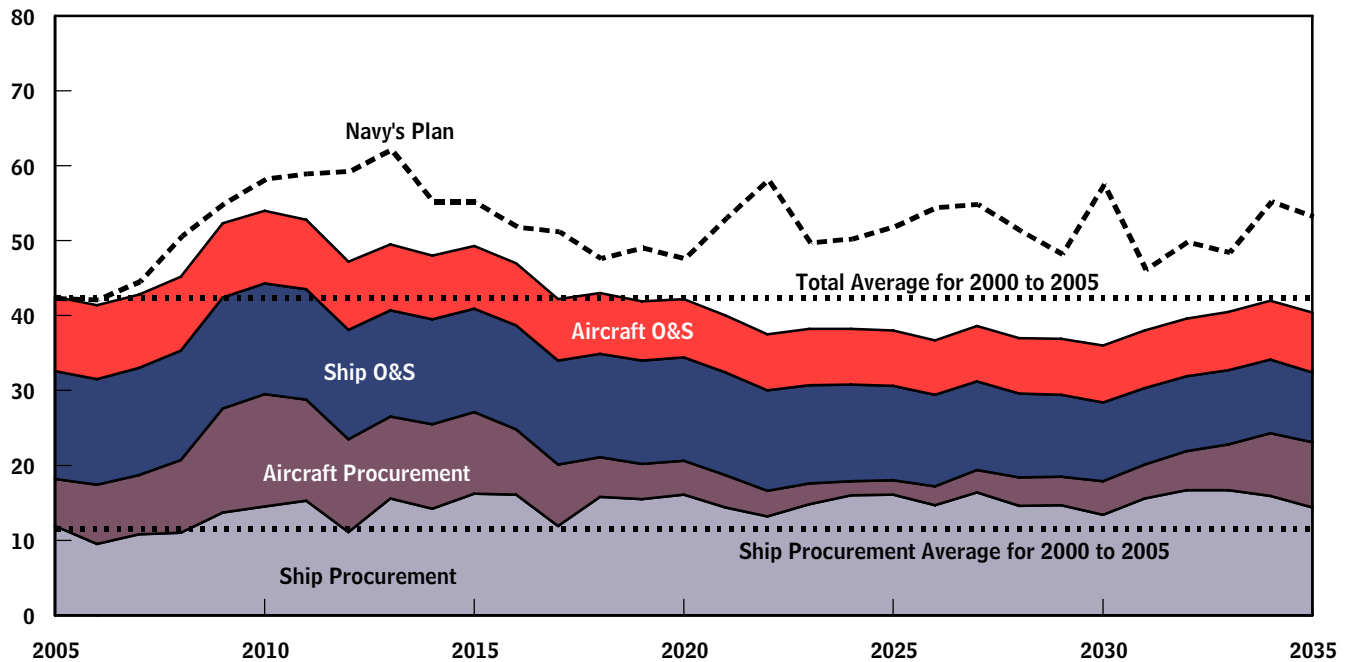
The amount of peacetime forward presence that those groups could provide would depend highly on whether the Navy continued and extended its Sea Swap crew-rotation practice on surface combatants. CBO assumed

that Sea Swap would increase the amount of presence provided by surface combatants by 38 percent. If the 54 cruisers and destroyers in this option employed the practice, they would offer the same amount of forward presence as 74 ships not using Sea Swap. Consequently, Option 1's 18 strike groups could provide as much peacetime forward presence as 24 strike groups would today.

Option 2: Emphasize the Navy's New Surface Combatants

As discussed in Chapter 2, the Navy has begun purchasing or is planning to buy three new types of surface combatant: the Freedom class littoral combat ship, starting last year; the DDG-1000 Zumwalt class destroyer, beginning in 2007; and the CG(X) cruiser, starting in 2011. Those ships are intended to introduce a variety of new capabilities to the fleet, but they also represent a substantial claim on shipbuilding resources.

The interim report on shipbuilding that the Navy released in March 2005 called for procuring eight to 12 Zumwalt (then called DD(X)) destroyers, 15 to 18 CG(X)s, and 63 to 82 LCSs. Later, in one of his last statements as Chief of Naval Operations, Admiral Vern Clark

Figure 3-2.**Ship and Aircraft Costs Under Option 1**

Source: Congressional Budget Office.

Notes: O&S = direct operation and support costs (those directly related to the number of ships or aircraft in the fleet, such as costs for fuel, supplies, and compensation of personnel).

Procurement costs for 2006 exclude supplemental funding related to Hurricane Katrina.

said that the Navy might want as many as 100 LCSs.⁷ However, the 313-ship requirement includes only 55 LCSs, as well as seven Zumwalts and 19 CG(X)s.

This alternative would pursue all three of the Navy's new surface combatants, buying the same number of Zumwalt destroyers and CG(X)s as the Navy's current plan (seven and 19) and the same number of LCSs as the 325-ship plan in the interim report (82). CBO chose the bigger LCS figure to highlight the belief of Navy officials such as Admiral Clark that large numbers of those small, fast warships will be necessary to counter the threats that are likely to emerge over the next several decades and to perform other missions.⁸ To pay for those surface combatants within the budgetary constraints of this analysis, Option 2 would reduce the number of aircraft carriers,

attack submarines, and amphibious ships by about 40 percent to 60 percent.

Although the alternatives in this study were not designed to address specific threats, this option would probably be better suited than the other four to fighting the war on terrorism. The large number of surface combatants, particularly LCSs, would allow the Navy to be in many places at once, conducting a variety of antiterrorist missions. Traditionally, such missions for surface combatants have included patrolling oceans and sea lanes, hunting and intercepting ships used by terrorists or pirates, engaging with allies in cooperative maritime security operations, and maintaining a visible presence around the

7. Scott C. Truver, "Transformation: A Bridge Too Far?" *Jane's Navy International* (March 2005), p. 25.

8. Recently, senior Navy officials stated that the service keeps thinking of new missions and tasks that the LCS will be able to perform. See Dave Ahearn, "Etter Sees New Missions for Littoral Combat Ships," *Defense Today* (January 20, 2006), and "LCS Uses May Include Fire Boat, Vehicle Transport, Search-and-Rescue," *Defense Today* (February 22, 2006).

globe.⁹ This option would be less well suited to a future conflict with China because of its large cuts in other types of ships, especially submarines.¹⁰

Ship Procurement Under Option 2

This alternative would build an average of 6.9 battle force ships (or about 49,000 tons of lightship displacement) annually between 2006 and 2035. Surface combatants would account for much of that construction: 67 percent by numbers and 44 percent by weight. On average, the Navy would build 4.6 cruisers, destroyers, and littoral combat ships (or around 21,000 tons of lightship displacement) per year under Option 2. All other types of ships would be built at low rates: an average of 0.1 per year in the case of amphibious ships and aircraft carriers and 0.9 per year in the case of attack submarines and support ships.

As in Option 1, this alternative would reduce the carrier force not by retiring Nimitzes early but by lowering procurement of the CVN-21 class. Only two of those new aircraft carriers would be purchased through 2035, the first not until 2026 (see Figure 3-3). Other cuts would be bigger than in the across-the-board alternative. Relative to the 2006 shipbuilding plan, the attack submarine force would shrink by nearly 40 percent, to 30 subs, and the number of amphibious ships would fall by more than half, to six expeditionary strike groups. Moreover, unlike Option 1, this alternative would not purchase any sea-basing ships. It would simply keep two of the existing maritime prepositioning squadrons to maintain two brigades' worth of equipment afloat. In addition, the number of forward-deployed Arleigh Burke destroyers and their replacements would be reduced to 28—enough to provide three escorts for each carrier strike group and expeditionary strike group in peacetime, assuming that the destroyers used Sea Swap crew rotation. As noted above, those reductions together would enable the Navy to buy seven Zumwalt class destroyers, 19 CG(X) cruisers, and 82 littoral combat ships through 2035 with no real increase in the service's average annual funding.

9. See Dave Ahearn, "Winter Says Piracy a Major Challenge for Navy," *Defense News* (January 12, 2006); Captain James Pelkofski, "Before the Storm: al Qaeda's Coming Maritime Campaign," *Proceedings*, U.S. Naval Institute (December 2005), pp. 20-24; and Geoffrey Till, "Navies and the New World Order," *Proceedings*, U.S. Naval Institute (March 2005), pp. 60-63.

10. See Eric Kimura, "A Gunboat Navy for the 21st Century," *Proceedings*, U.S. Naval Institute (July 2005), pp. 44-46.

Like the previous alternative, this option would expand the battle force fleet from 285 ships to 300 by 2020.

Those ships would include:

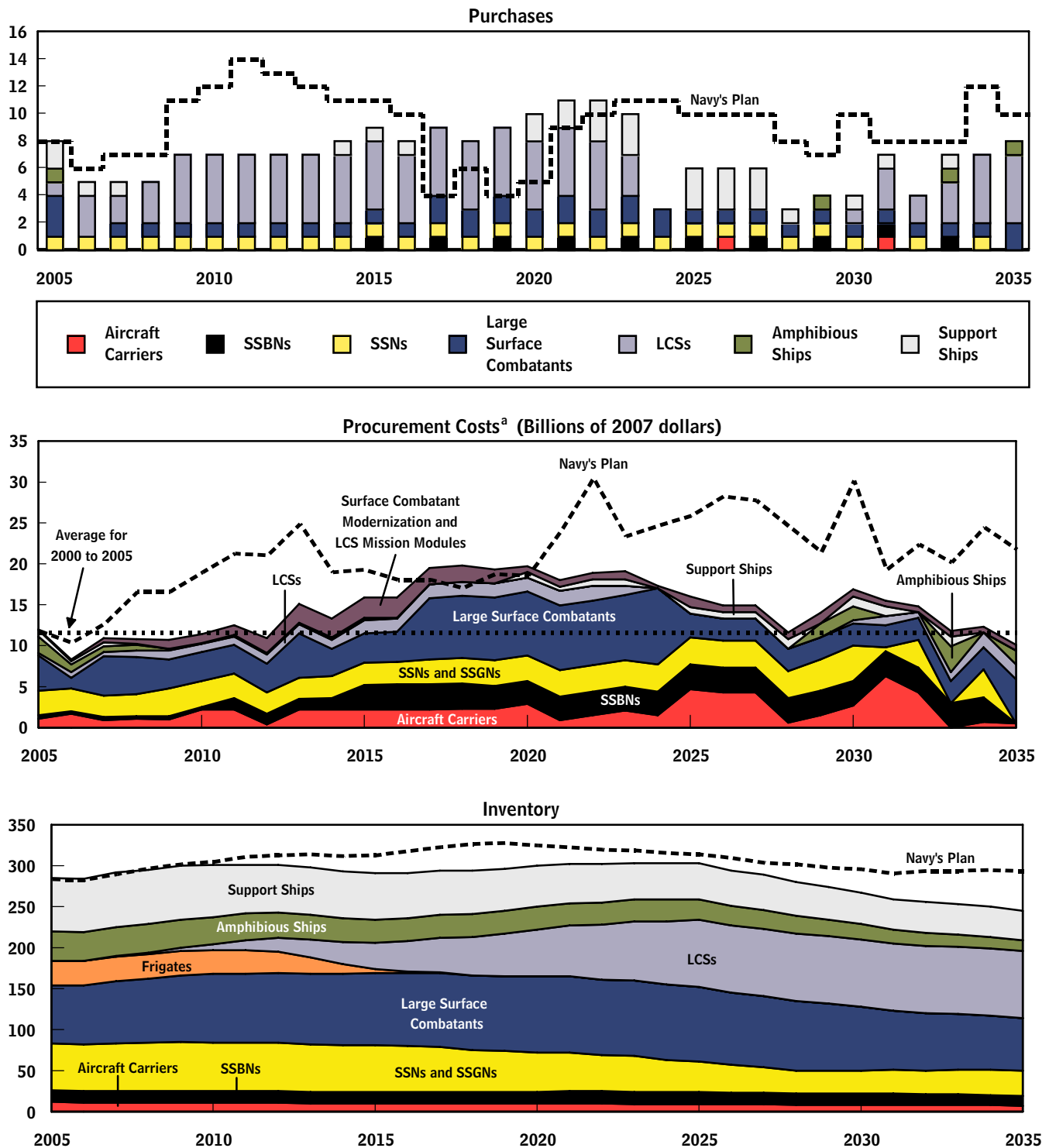
- 10 aircraft carriers,
- 14 ballistic missile submarines,
- 44 attack submarines,
- 4 guided missile submarines,
- 93 large surface combatants,
- 57 littoral combat ships,
- 28 amphibious ships, and
- No sea-basing-capable maritime prepositioning ships.

By 2035, however, the total number of battle force ships would fall to 246 under this option. Each major category of ship would remain at relatively high levels through 2015 but then decline gradually as fewer ships were purchased to replace the ships that reached their retirement age. By 2035, the fleet would include:

- 7 aircraft carriers,
- 12 ballistic missile submarines,
- 31 attack submarines,
- 64 large surface combatants,
- 82 littoral combat ships,
- 13 amphibious ships, and
- No sea-basing-capable maritime prepositioning ships.

Aircraft Procurement Under Option 2

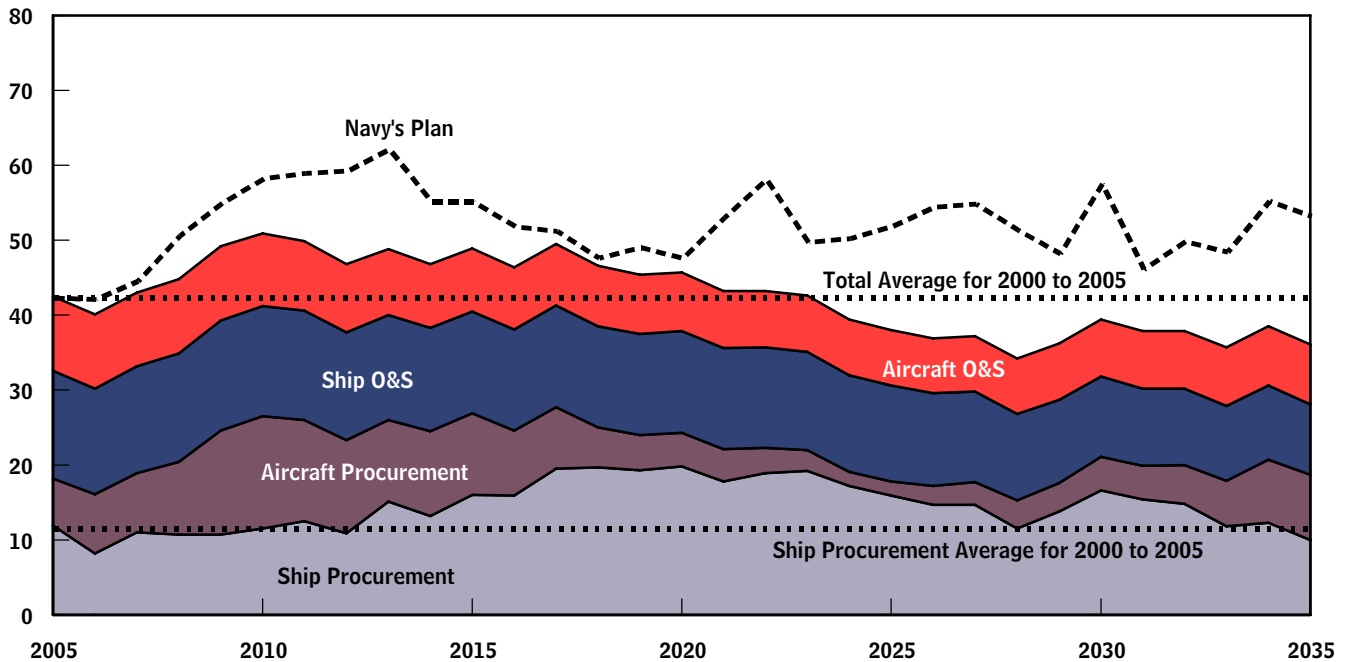
This alternative would make the same reductions in the Navy's aircraft programs as would Option 1 (the across-the-board cuts). The number of deployable carrier air wings would be reduced to six from 10 under the Navy's current plan, with no reserve air wing. Consequently, aircraft procurement would decline by 150 for Joint Strike Fighters, 20 for F/A-18G Growlers, 28 for E-2Cs, a total of 117 for MH-60R and MH-60S helicopters, and 28 for

Figure 3-3.**Purchases, Costs, and Inventory of Battle Force Ships Under Option 2**

Source: Congressional Budget Office.

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

a. Data for 2006 exclude supplemental funding related to Hurricane Katrina.

Figure 3-4.**Ship and Aircraft Costs Under Option 2**

Source: Congressional Budget Office.

Notes: O&S = direct operation and support costs (those directly related to the number of ships or aircraft in the fleet, such as costs for fuel, supplies, and compensation of personnel).

Procurement costs for 2006 exclude supplemental funding related to Hurricane Katrina.

UCAVs. In all, those reductions would save a total of about \$14 billion between 2006 and 2035 compared with the Navy's plan.

Costs of Option 2

Average annual costs through 2035 would be much the same under this alternative as under Option 1: \$14.6 billion to buy ships and \$12.8 billion to operate them (falling to \$9.4 billion by 2035, see Figure 3-4), as well as \$7.0 billion to purchase aircraft and \$8.2 billion to operate them. Thus, total annual procurement and O&S costs for ships and aircraft would average \$42.6 billion under this alternative. (If the ships in this option were bought at a steady-state rate, they would require about \$14.4 billion in average annual procurement funding.)

Steady-State Composition of the Fleet Under Option 2

In building new classes of surface combatants within recent funding levels, this alternative would result in a steady-state fleet of 233 battle force ships—about one-

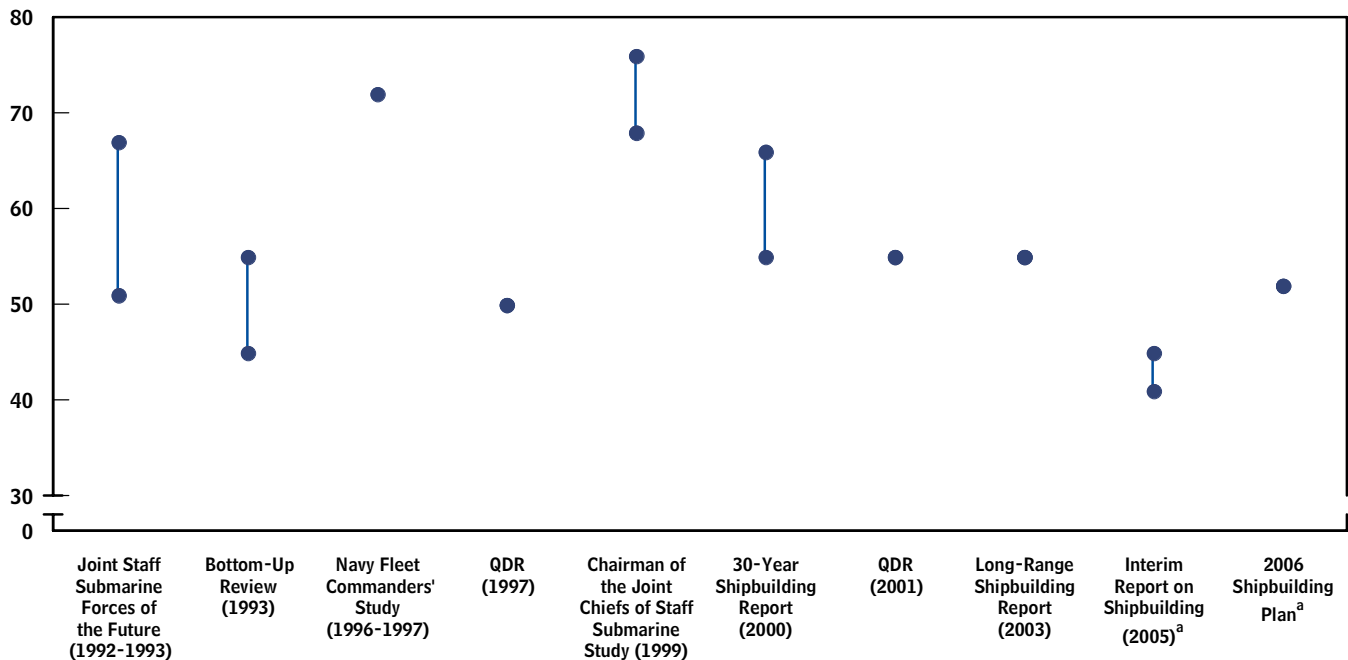
fifth smaller than today's fleet. The total number of strike groups would be reduced to 18, as under Option 1, but with seven carrier strike groups, six expeditionary strike groups, and five surface action groups. If this option's 54 cruisers and destroyers were operated using Sea Swap, those 18 strike groups could provide the same amount of peacetime overseas presence as 25 strike groups would today.

Option 3: Maintain 55 Attack Submarines over the Long Term

In recent years, the future size of the attack submarine (SSN) force has become one of the most prominent issues in naval planning. Currently, the Navy has 57 SSNs (including four SSGNs, former ballistic missile submarines that were converted to a conventional configuration). However, the Navy has been buying new attack submarines at an average pace of less than one per year since 1991. That procurement rate would result in a steady-state force of about 30 submarines. Many observ-

Figure 3-5.

Number of Attack Submarines the Navy Needs, According to Various Defense Department Analyses



Source: Congressional Budget Office.

Note: QDR = Quadrennial Defense Review.

a. Includes four guided missile submarines (SSGNs).

ers argue that the United States will need a much larger SSN force than that.¹¹

Various studies by the Department of Defense and the Navy have reached widely differing conclusions over the years about how many attack submarines the Navy requires (see Figure 3-5). For example, a 1999 analysis conducted by the Joint Staff for the Chairman of the Joint Chiefs of Staff stated that between 68 and 76 submarines were necessary to perform peacetime missions (although 55 would be sufficient to meet wartime needs). In 2003, the Navy's long-range shipbuilding report called for 55 attack submarines. Two years later, the Navy stated that its future fleet would need between 41 and 45 attack submarines, including four guided missile submarines. Most recently, the 313-ship requirement includes 48 attack submarines and four SSGNs.

In light of that history, this alternative would build attack submarines at a rate that would eventually result in a force of 55 SSNs—20 to 25 more than in the other options in this study. The force would be smaller than 55 submarines throughout the 2020s, however, because otherwise the Navy would need to purchase three submarines per year in 14 of the next 30 years. Such a procurement rate would be virtually impossible within the resource constraints of this analysis, given the other demands on the Navy's shipbuilding budget. Even so, to maintain a force of 55 attack submarines without a real increase in total funding, the Navy would have to delay or cancel most other major planned ship programs.

With its emphasis on submarines, this option's fleet would be better suited than those of the other four alternatives to a war with a near-peer competitor, such as China. Observers of the Chinese military have particularly noted its development and purchase of various types of submarines, which would probably pose the greatest threat to U.S. naval forces in a military confrontation

11. See, for example, Robert A. Hamilton, "Admiral: More Subs Needed, Top Submariner Sees Shrinking Fleet as Risky Option," *The Day* (New London, Conn.), June 14, 2005.

with that country.¹² The most effective weapon against submarines is generally considered to be another submarine. Furthermore, some observers fear that China's continued investment in antiship missiles and sophisticated radars and tracking systems could make it difficult for U.S. surface ships to operate near Chinese waters.¹³ Conversely, this option would not be as well suited as some others to perform extensive sea-control and maritime interception operations because of its relatively small number of surface ships.

Ship Procurement Under Option 3

The Navy would build an average of 6.2 ships (or about 45,000 tons of lightship and Condition A displacement) per year under this alternative. In numerical terms, attack submarines and littoral combat ships—at 1.9 and 2.4 per year, respectively—would make up nearly three-quarters of total purchases. The remaining categories of ships would be bought in much smaller quantities. Procurement would average less than 0.1 aircraft carriers, slightly more than 0.1 amphibious ships, and 0.6 large surface combatants annually.

The picture looks somewhat different when weight is used as the measure. Attack submarines and littoral combat ships together would account for about 18,000 tons of construction per year, or 40 percent of the total annual average. Aircraft carriers would be built at an average rate of about 8,000 tons a year, or 17 percent of the total. The other categories of ships would each account for between 7 percent and 12 percent of total average construction, by weight.

To pay for this option's higher rate of submarine procurement, most other major ship programs would be postponed or terminated (see Figure 3-6). The number of aircraft carriers would be reduced from the planned 11 to eight. To replace some retiring carriers, three CVN-21s would be purchased through 2035, the first in 2021 (13 years later than under the Navy's current plan). The

Zumwalt class destroyer and CG(X) cruiser programs would be canceled, and the number of large surface combatants would be halved to 31 from the Navy's planned 62. As a result, a replacement for existing Arleigh Burke class destroyers would start being purchased in 2019 at a rate of one per year. As in the surface combatant alternative (Option 2), the number of amphibious ships would be reduced to 13, the sea-basing-capable MPF(F) program would be eliminated, and two existing conventional maritime prepositioning squadrons would be retained.

The savings from those various cuts would be used to purchase Virginia class submarines as well as replacements for the Ohio class SSGNs that the Navy is now acquiring. Because those SSGNs are conversions of existing ballistic missile submarines, they will reach the end of their service life in the mid-2020s. (If SSGNs were deemed not worth replacing but the money was still devoted to submarines, the Navy could buy approximately six more Virginias, bringing the total attack submarine force to 61.)

The total number of battle force ships would rise slightly under this option to 296 by 2020, compared with 285 now. In 2020, the fleet would include:

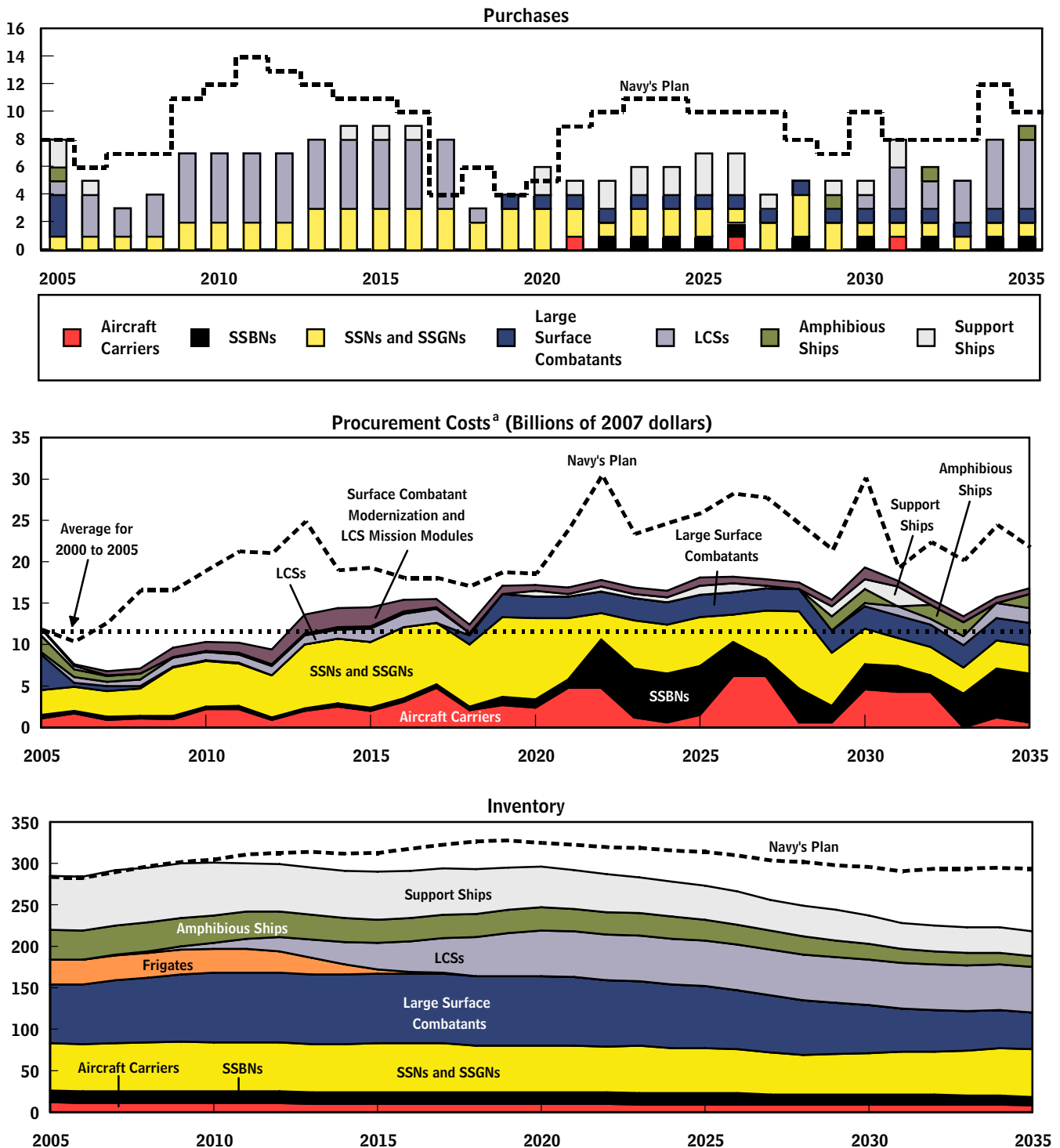
- 10 aircraft carriers,
- 14 ballistic missile submarines,
- 52 attack submarines,
- 4 guided missile submarines,
- 84 large surface combatants,
- 55 littoral combat ships,
- 28 amphibious ships, and
- No sea-basing-capable maritime prepositioning ships.

Over the following 15 years, however, the size of the fleet would gradually decline to 219 ships as fewer new vessels were bought to replace the ships that reached their retirement age. By 2035, the fleet would include:

- 8 aircraft carriers,
- 10 ballistic missile submarines,

12. Joe Butt, "Will China Rule the Waves?" *Submarine Review* (January 2006), pp. 7-30.

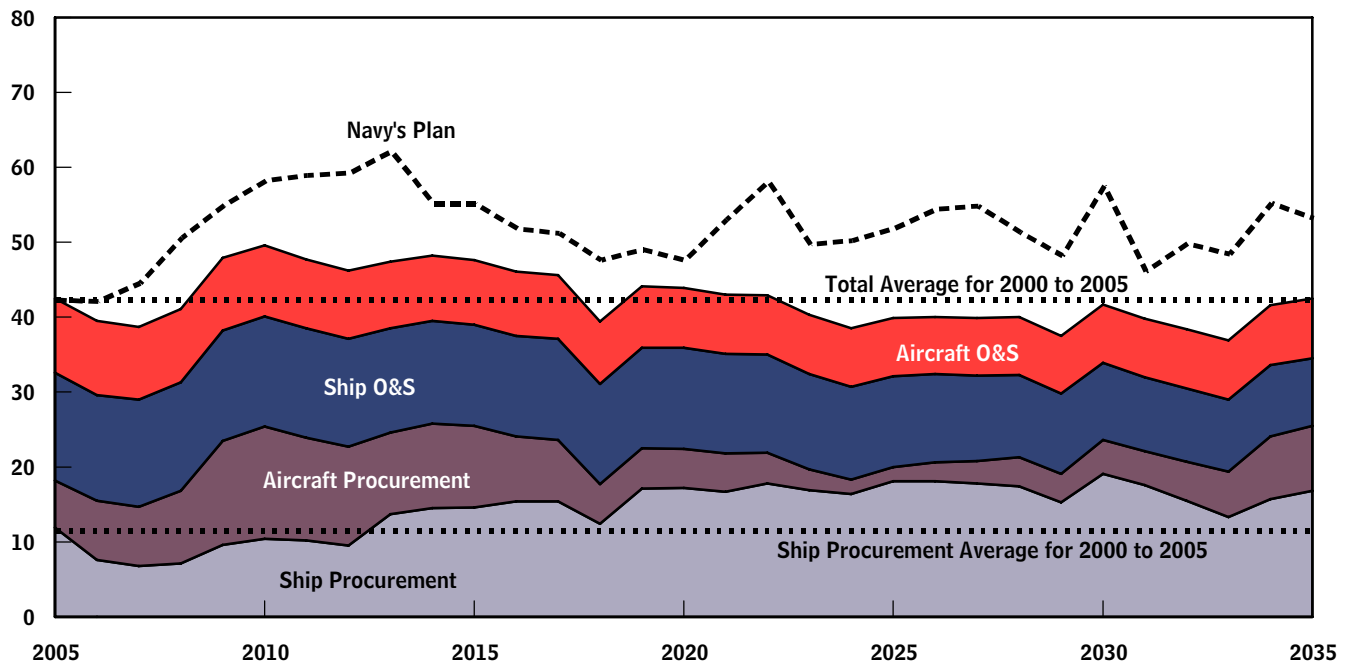
13. For a good overview of that issue, see Ronald O'Rourke, *China Naval Modernization: Implications for U.S. Naval Capabilities—Background and Issues for Congress*, Report for Congress RL33153 (Congressional Research Service, February 13, 2006). Also see Massimo Annati, "China's PLA Navy, the (R)evolution," *Naval Forces*, no. 6 (2004), pp. 66-75.

Figure 3-6.**Purchases, Costs, and Inventory of Battle Force Ships Under Option 3**

Source: Congressional Budget Office.

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

a. Data for 2006 exclude supplemental funding related to Hurricane Katrina.

Figure 3-7.**Ship and Aircraft Costs Under Option 3**

Source: Congressional Budget Office.

Notes: O&S = direct operation and support costs (those directly related to the number of ships or aircraft in the fleet, such as costs for fuel, supplies, and compensation of personnel).

Procurement costs for 2006 exclude supplemental funding related to Hurricane Katrina.

- 54 attack submarines,
- 4 guided missile submarines,
- 44 large surface combatants,
- 55 littoral combat ships,
- 13 amphibious ships, and
- No sea-basing-capable maritime prepositioning ships.

Aircraft Procurement Under Option 3

This alternative would cut the number of deployable carrier air wings to seven, one more than in the previous two options. The reductions in individual aircraft would be less than under those options: 106 Joint Strike Fighters, 14 F/A-18G Growlers, 21 E-2Cs, 96 MH-60R and MH-60S helicopters, and 28 UCAVs. Consequently, the cost savings would also be lower: about \$10 billion over the 30-year period.

Costs of Option 3

If the Navy focused on keeping the SSN force at 55 within current funding levels, as envisioned in this option, it would spend an average of \$14.5 billion on ship procurement and \$7.1 billion on aircraft procurement per year between 2006 and 2035. (Buying this option's ships at a steady-state rate would entail \$14.3 billion in annual shipbuilding costs, on average.)

Operation and support costs for ships would average about \$12.5 billion over the next 30 years but would end that period at less than \$9 billion (see Figure 3-7). O&S costs for naval aircraft would average \$8.4 billion per year. Thus, the total cost of sustaining and operating the Navy's fleets of ships and aircraft under this option would be an average of \$42.5 billion per year through 2035.

Steady-State Composition of the Fleet Under Option 3

This option's approach would produce a steady-state fleet of 207 battle force ships, a slightly larger reduction than

the across-the-board cuts in Option 1. As in the previous alternatives, the number of strike groups would decline to 18—but with some important differences. The Navy would have eight carrier strike groups, six expeditionary strike groups, and four SSGN strike forces. There would be no surface action groups.

Moreover, 11 of the strike groups would nominally include only two surface combatants rather than the usual three. However, if the 31 destroyers in this option used rotating crews, they would provide the same amount of forward presence as 42 ships not using Sea Swap. Thus, those destroyers would be sufficient to support the carrier and expeditionary strike groups with three surface combatants each when they deployed overseas in peacetime.

Option 4: Maintain 11 Aircraft Carriers over the Long Term

The number of aircraft carriers that the Navy needs has also been a contentious issue recently. Last year, when the Navy proposed reducing the carrier force from 12 to 11 as part of the President's budget request for 2006, the Congress responded with legislation requiring the service to keep 12 operational aircraft carriers in its fleet.¹⁴ Nevertheless, the 2006 shipbuilding plan released in February set the Navy's requirement for carriers at 11, and the Chief of Naval Operations explicitly endorsed that number in public statements.¹⁵ Recently, the Senate indicated that it would accede to the Navy's request to reduce the fleet to 11 carriers, but the House opted to preserve the 12-ship requirement for the time being.

Consistent with the Navy's requirement, this option would maintain a carrier force of at least 11 ships—three or four more than in the other options in this analysis. To pay for keeping 11 carriers and 10 air wings without a

real increase in funding, this option would reduce or eliminate all other ship construction programs.

Aircraft carriers represent the core of the Navy and are one of the most flexible instruments of military power. Nevertheless, some analysts have argued that large numbers of carriers are not a necessity either for future operations in the war on terrorism or for a possible military confrontation with China. The ability to mass a force of five or six carriers to hit thousands of military targets per day from the sea is probably not required to pursue a highly dispersed enemy, such as a group of terrorist cells. Carriers did prove useful in operations in land-locked Afghanistan. But terrorists may be unlikely to concentrate and essentially take over an entire state again, as occurred there.

Similarly, in any future conflict with China, carriers would represent an important element of the U.S. military response. However, in 20 or 30 years, concerns about their potential vulnerability to Chinese ballistic and anti-ship cruise missiles or quiet submarines could make the Navy reluctant to give such high-value assets a prominent role in the conflict. Stopping a Chinese invasion of Taiwan, for example, might be better done with attack submarines and other weapons such as cruise missiles or stealthy long-range bombers.

Advocates of a large carrier force argue that it has two significant advantages. A force big enough to allow two or three carriers to be deployed overseas at all times enables the United States to respond quickly to any unfolding crisis around the globe. Supporters of carriers often cite the fact that when a crisis occurs, one of the first questions from policymakers is about the location of the nearest carrier, shortly followed by directions to redeploy the ship to the trouble spot. That reaction is significant because, unlike any other warship in the U.S. fleet, an aircraft carrier alone is capable of striking hundreds of targets per day for more than a month, using modern aircraft and precision munitions.

The second major advantage follows closely from the first: aircraft carriers do not require the support of another government to commence operations. Thus, they provide a freedom of action that is paralleled only by the United States' fleet of intercontinental bombers. (Other Navy ships have the same freedom, of course, but they do not have the carriers' striking power.) In the view of some observers, having 11 aircraft carriers is the best way to

14. The 2006 National Defense Authorization Act (Public Law 109-163) states that, "The naval combat forces of the Navy shall include not less than 12 operational aircraft carriers. For purposes of this subsection, an operational aircraft carrier includes an aircraft carrier that is temporarily unavailable for worldwide deployment due to routine or scheduled maintenance or repair." The effect of that provision is to give the size of the carrier fleet the force of law, similar to statutory provisions that mandate the size of the Marine Corps.

15. Dave Ahern, "Mullen: Four Ships Too Few; Stable Ship Funds Needed," *Defense Today* (October 13, 2005).

preserve the Navy's crisis-response capability and freedom of action.¹⁶

Ship Procurement Under Option 4

Because of the relatively high per-ship cost of aircraft carriers, this alternative would have the lowest shipbuilding rate of the options in CBO's analysis. Under this approach, the Navy would procure an average of 5.2 ships per year through 2035. Carriers would represent just 4 percent of that shipbuilding in terms of numbers: an average of 0.2 per year, or one new carrier every five years. In terms of weight, however, carriers would make up about 33 percent of the 48,000 tons of lightship displacement built each year, on average. That total amount of displacement is about half of the average since 2000.

This option would buy six CVN-21s through 2035 (see Figure 3-8), as well as eight CG(X) cruisers to provide missile defense to carrier strike groups. The program to build DDG-1000 Zumwalt class destroyers would be canceled to free up money for aircraft carriers and their air wings. In all, the force of large surface combatants would number 46 ships, requiring the Navy to start buying replacements for Arleigh Burke class destroyers in 2021, at the end of the CG(X) program. The planned number of littoral combat ships would be cut by one-quarter to 40—an average of 1.9 (or about 4,300 tons) built per year during the 2006-2035 period. The attack submarine fleet would be reduced to 30 from the planned 48 by building 0.9 submarines (about 5,800 tons) per year, on average.

As in most of the previous options, the amphibious force would be cut by more than half to 13 ships. Amphibious ships and support ships together would be built at an average rate of 0.8 (or about 10,000 tons of lightship displacement) per year. Like the surface combatant and submarine alternatives (Options 2 and 3), this option would not introduce sea-basing capability to the maritime prepositioning force. Instead, it would maintain two of the existing maritime prepositioning squadrons to store enough equipment for two Marine expeditionary brigades.

Unlike in the other options, the battle force fleet would be smaller in 2020 under this alternative, at 278 ships, than it is today. That fleet would include:

- 11 aircraft carriers,
- 14 ballistic missile submarines,
- 44 attack submarines,
- 4 guided missile submarines,
- 88 large surface combatants,
- 40 littoral combat ships,
- 28 amphibious ships, and
- No sea-basing-capable maritime prepositioning ships.

Thereafter, the size of the fleet would decline fairly sharply as the large numbers of attack submarines and surface combatants built in the 1980s and 1990s were retired but not replaced. By 2035, the fleet would number just 189 battle force ships, including:

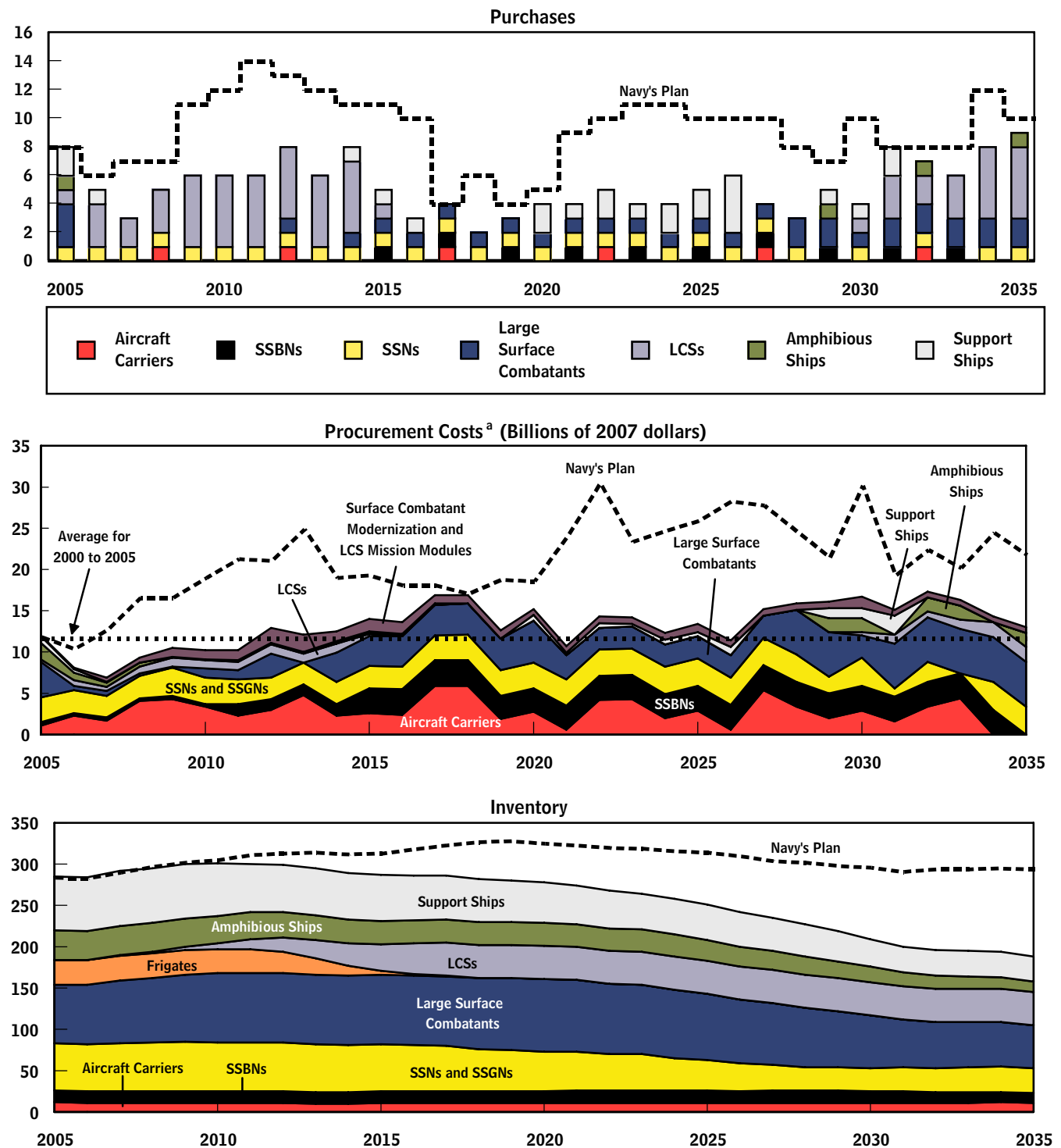
- 11 aircraft carriers,¹⁷
- 12 ballistic missile submarines,
- 30 attack submarines,
- 52 large surface combatants,
- 40 littoral combat ships,
- 13 amphibious ships, and
- No sea-basing-capable maritime prepositioning ships.

Aircraft Procurement Under Option 4

This option would maintain 10 deployable air wings for use on the 11 carriers, as well as one nondeployable reserve air wing. Consequently, aircraft procurement would be the same as in the Navy's plan (described in Chapter 2).

16. See Vice Admiral Walter B. Massenberg, Vice Admiral James M. Zortman, and Rear Admiral Thomas J. Kilcline Jr., "Naval Aviation: Forward, Persistent, and Dominant," *Proceedings*, U.S. Naval Institute (October 2005), pp. 34-37.

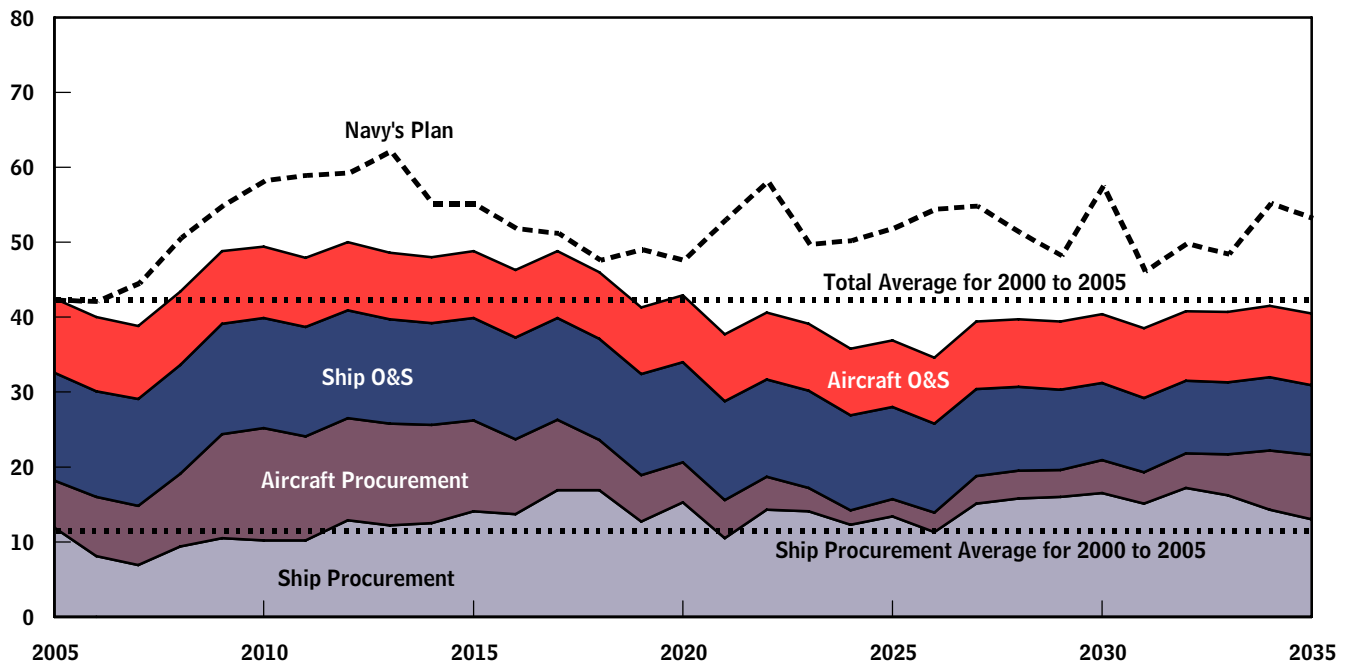
17. In this option alone, several Nimitz class aircraft carriers would be retired a few years early so as not to exceed the 11-carrier requirement in the 2020s and 2030s.

Figure 3-8.**Purchases, Costs, and Inventory of Battle Force Ships Under Option 4**

Source: Congressional Budget Office.

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

a. Data for 2006 exclude supplemental funding related to Hurricane Katrina.

Figure 3-9.**Ship and Aircraft Costs Under Option 4**

Source: Congressional Budget Office.

Notes: O&S = direct operation and support costs (those directly related to the number of ships or aircraft in the fleet, such as costs for fuel, supplies, and compensation of personnel).

Procurement costs for 2006 exclude supplemental funding related to Hurricane Katrina.

Costs of Option 4

This approach would entail the lowest average ship procurement costs of the five options, about \$13.2 billion per year through 2035, but the highest aircraft procurement costs, an average of \$7.5 billion. (If ships were bought at a steady-state rate, they would cost \$13.2 billion.) Operation and support costs would average \$12.6 billion annually for Navy ships and \$9.2 billion for aircraft. In all, then, average annual costs over the 30-year period would total \$42.5 billion (see Figure 3-9).

Steady-State Composition of the Fleet Under Option 4

Maintaining a force of 11 aircraft carriers indefinitely with no real increase in funding would produce the smallest steady-state fleet of the options in this analysis—181 battle force ships. The number of strike groups in that fleet would fall to 17: 11 carrier strike groups and six expeditionary strike groups. Six of the strike groups would nominally have only two large surface combatants.

But as in all of the other options, large surface combatants would employ rotating crews. Consequently, the 46 large surface combatants in this alternative would provide as much presence as 62 ships, and each carrier or expeditionary strike group would be able to deploy overseas in peacetime with three surface combatants.

Option 5: Deploy and Maintain a Robust Sea-Basing Capability

As described in Chapter 1, when the Navy unveiled its Sea Power 21 vision for transforming the fleet, sea basing was viewed as the most transformational and innovative of the three concepts underlying that vision. The central tenet behind sea basing is that the Navy and Marine Corps should reduce the need for support from land facilities as much as possible—preferably to zero—in the initial phases of a military operation. Such a reduction would give U.S. forces a high degree of freedom of action. That would be true in small noncombat operations (such as providing humanitarian aid) or in larger military oper-

ations involving one or more Marine infantry brigades. The most expansive visions of sea basing have described conducting an operation such as the invasion of Iraq, which involved 130,000 troops, without using Kuwait as an initial operating base.

The Navy can perform small sea-basing operations today, such as its relief efforts after the Asian tsunami or small special operations launched from ships or submarines. However, the Navy is not equipped to support brigade-sized military operations from ships alone. To do that, it hopes to buy ships configured to provide most, if not all, logistical support for a land-based force from the sea. Such ships would be formed into MPF(F) squadrons, each of which could deploy and sustain a Marine expeditionary brigade for 20 days. (After that, supplies arriving from the continental United States would be funneled either through the “sea base” or through a land base that would have been established in the first weeks of the operation.) The MPF(F) squadrons would replace the Navy’s existing maritime prepositioning squadrons, which are composed of cargo vessels that carry equipment and supplies for three Marine expeditionary brigades but that require deep-water ports and established facilities to unload their cargo.

The Navy has defined what a sea-basing squadron would look like (see Chapter 2) and envisions buying one such formation under the 2006 shipbuilding plan. For its part, the Marine Corps has stated a desire to have at least two such squadrons forward deployed so they would be in a position to respond quickly to any crisis that arose in the Middle East, southern Africa, or East Asia.

This option would buy two sea-basing-capable MPF(F) squadrons and also maintain nine expeditionary strike groups to ensure sufficient support from traditional amphibious ships in any expeditionary operation. Because they would provide a readily usable combat capability, the ships of an MPF(F) squadron would be counted as battle force ships—unlike the conventional cargo ships that make up maritime prepositioning squadrons today.

This alternative would probably be better suited than any other in CBO’s study to a future world that was increasingly chaotic and required frequent U.S. military interventions. Some analysts and scholars have argued that the world is becoming divided between countries that are functioning well within the increasingly global economy

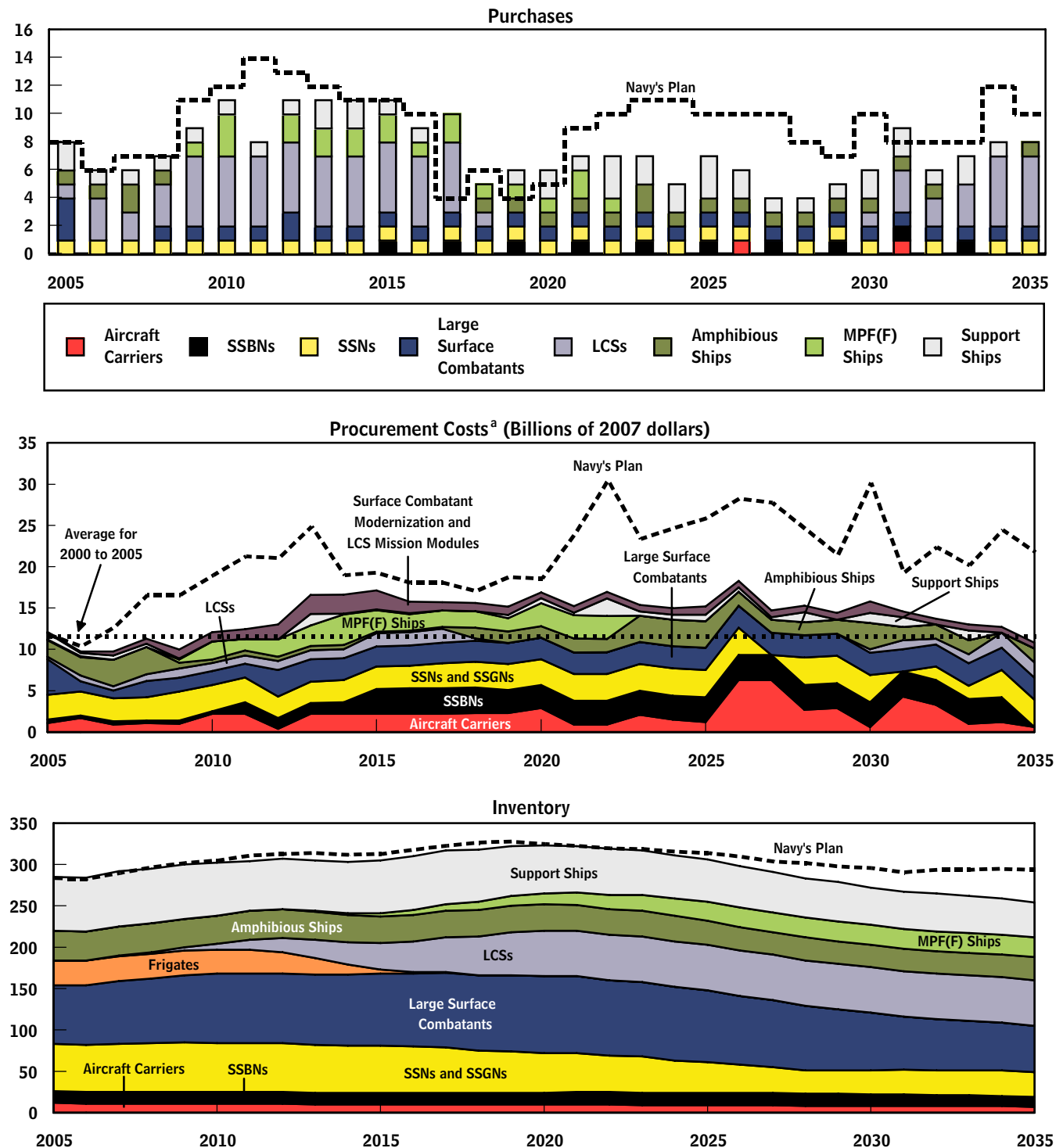
and countries that are not. According to that view, the latter group of states represents the most likely places for U.S. involvement in the future. (That vision contrasts with the Cold War, when the central front of the U.S.-Soviet confrontation was the heart of Europe.) If the United States found itself more and more involved in areas with weak governments, civil wars, or ethnic conflict, the sea-basing capability provided by this option would probably prove more useful than the large surface combatants of Option 2, the attack submarines of Option 3, or the sizable carrier force of Option 4.

Ship Procurement Under Option 5

Under this approach, the Navy would purchase an average of 7.2 ships a year between 2006 and 2035. Sea-basing and amphibious ships, however, would make up just one-fifth of that number, or 1.4 ships per year. Surface combatants, mostly littoral combat ships, would be built at a rate of 2.4 per year. Attack submarines would be bought at an average rate of a little less than 1.0 per year and carriers at 0.1 per year.

As in the carrier option, the shipbuilding picture would be quite different when viewed by weight. This alternative would build a larger amount of lightship and Condition A displacement each year—about 77,000 tons, on average—than the other four options. Sea-basing and amphibious ships would account for 46 percent of that total average displacement (25,000 tons per year for MPF(F) ships and 10,000 tons for amphibious ships). Average annual production of surface combatants would equal 10,800 tons; carriers, 5,200 tons; and attack submarines, 5,800 tons.

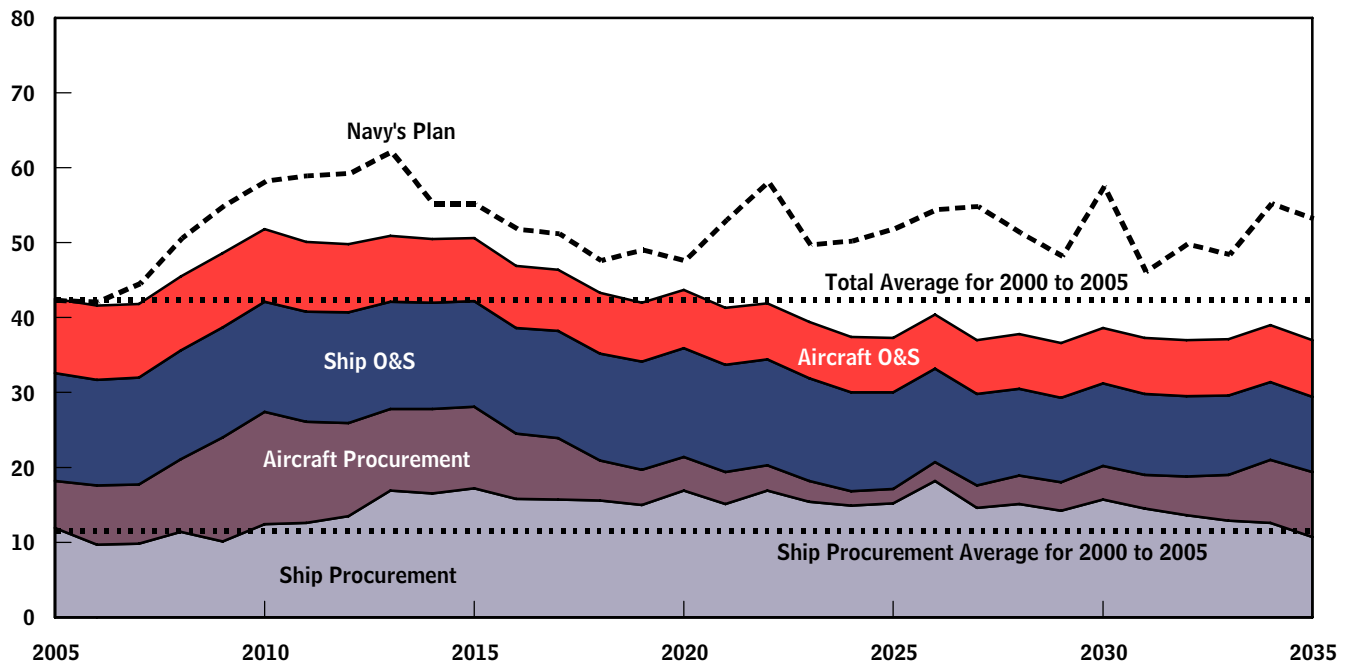
With respect to individual ship programs, this option would buy only two CVN-21 carriers between 2006 and 2035, for a total carrier force of seven (see Figure 3-10). Both the Zumwalt class destroyer and CG(X) cruiser programs would be canceled to save money. The number of Arleigh Burke class destroyers and their replacements would be maintained at 38 (about three-fifths of the Navy’s planned force). This option would also purchase 55 littoral combat ships, as in the Navy’s plan. The attack submarine force would be reduced by nearly 40 percent to 30 SSNs. The amphibious fleet would number 28 ships—the largest among the options in this analysis—with another 24 sea-basing ships composing the two MPF(F) squadrons.

Figure 3-10.**Purchases, Costs, and Inventory of Battle Force Ships Under Option 5**

Source: Congressional Budget Office.

Note: SSBNs = ballistic missile submarines; SSNs = attack submarines; SSGNs = guided missile submarines; LCSs = littoral combat ships; MPF(F) = Maritime Prepositioning Force (Future).

a. Data for 2006 exclude supplemental funding related to Hurricane Katrina.

Figure 3-11.**Ship and Aircraft Costs Under Option 5**

Source: Congressional Budget Office.

Notes: O&S = direct operation and support costs (those directly related to the number of ships or aircraft in the fleet, such as costs for fuel, supplies, and compensation of personnel).

Procurement costs for 2006 exclude supplemental funding related to Hurricane Katrina.

In addition, because this option emphasizes sea basing, it would acquire the fire-support capability of the canceled Zumwalt class destroyers by purchasing a new type of naval vessel: an LPD-17 fire-support ship. That ship would consist of a San Antonio class amphibious transport dock fitted with two Advanced Gun Systems (with a total magazine of 900 shells) and 16 vertical launch system cells. (For a discussion of the feasibility of such as ship, see Box 3-1.) Under this option, the Navy would buy seven of the modified LPD-17s through 2035.

The total number of battle force ships would increase significantly in the next 15 years under this alternative: to 323 by 2020. That fleet would include:

- 10 aircraft carriers,
- 14 ballistic missile submarines,
- 44 attack submarines,
- 4 guided missile submarines,

- 86 large surface combatants,
- 55 littoral combat ships,
- 32 amphibious ships, and
- 13 sea-basing-capable maritime prepositioning ships.

By 2035, the battle force fleet would drop below the current size of 285 ships to 255 ships. That number is larger than in the other four options because the decline in large surface combatants and attack submarines in the early 2020s would be partly offset by the introduction of 24 MPF(F) ships. In 2035, the fleet would include:

- 7 aircraft carriers,
- 12 ballistic missile submarines,
- 30 attack submarines,
- 49 large surface combatants,

Box 3-1.**Creating an LPD-17 Fire-Support Ship**

The sea-basing alternative in this analysis (Option 5) envisions creating a modified ship to provide naval surface fire support to forces operating on shore. The modification would involve installing vertical launch system (VLS) cells and two Advanced Gun Systems (AGSs) on the hull of an LPD-17 San Antonio class amphibious transport dock. The resulting ship would provide the same main battery as the Navy's planned Zumwalt class destroyer but would use a much less expensive platform that is already in serial production.

When the LPD-17's hull was designed, space was reserved to accommodate a bank of 16 VLS cells in the front of the ship, which would be used primarily for self-defense. In the fire-support version of the ship, those cells could contain up to 64 Enhanced Sea Sparrow missiles to defend against antiship cruise missiles or a mix of various existing and newly designed ship-defense weapons. The modified LPD-17 would have other layers of self-defense as well, including the Phalanx Close-in Weapon System and batteries of the Rolling Airframe Missile (which is also being included on the amphibious version of the LPD-17). Alternatively, land-attack missiles could be installed in some of the VLS cells.

Recent press reports have discussed the feasibility of using the LPD-17 hull for other purposes, such as adding Advanced Gun Systems.¹ In the Congressional Budget Office's (CBO's) conception of a fire-support LPD-17, two Advanced Gun Systems would be installed in the back of the ship (see the drawing at right), with a total magazine of about 900 shells.

Designing and building a fire-support LPD-17 would require making some changes to the ship as well as giving up some capabilities of the LPD-17 class. The ship's electronics and combat systems would need improvements to use the AGSs effectively. Moreover, some internal rearrangement would be necessary to accommodate two AGSs in the rear of the ship and 16 VLS cells in the front. In particular, the hangar facilities for helicopters would be eliminated, reducing the ship's aviation capability. A landing spot for a CH-53-size helicopter would remain, however. The ship's well deck would also be eliminated to provide internal space for the AGS magazine.

1. Christopher Cavas, "More Than an Amphib? Experts Evaluate the U.S. Navy's LPD-17," *Defense News* (January 9, 2006).

- 7 LPD-17 fire-support ships,
- 55 littoral combat ships,
- 28 amphibious ships, and
- 24 sea-basing-capable maritime prepositioning ships.

Aircraft Procurement Under Option 5

With a force of seven aircraft carriers, this alternative would reduce the number of deployable carrier air wings from 10 to six and eliminate the reserve wing. As a result, it would cut aircraft procurement over the 2006-2035 period by 150 Joint Strike Fighters, 20 F/A-18G Growlers,

28 E-2Cs, 117 MH-60R and MH-60S helicopters, and 28 unmanned combat air vehicles. (No other changes would be made to the Navy's long-term plans for aviation.) Overall, those reductions would save about \$14 billion through 2035 compared with the Navy's plan.

Costs of Option 5

The sea-basing squadrons and other ships in this alternative would cost an average of about \$14.3 billion per year to procure through 2035. (Steady-state costs for those ships would average \$13.6 billion per year.) Aircraft procurement would cost another \$7.0 billion annually, on average. Ship operation and support costs would average

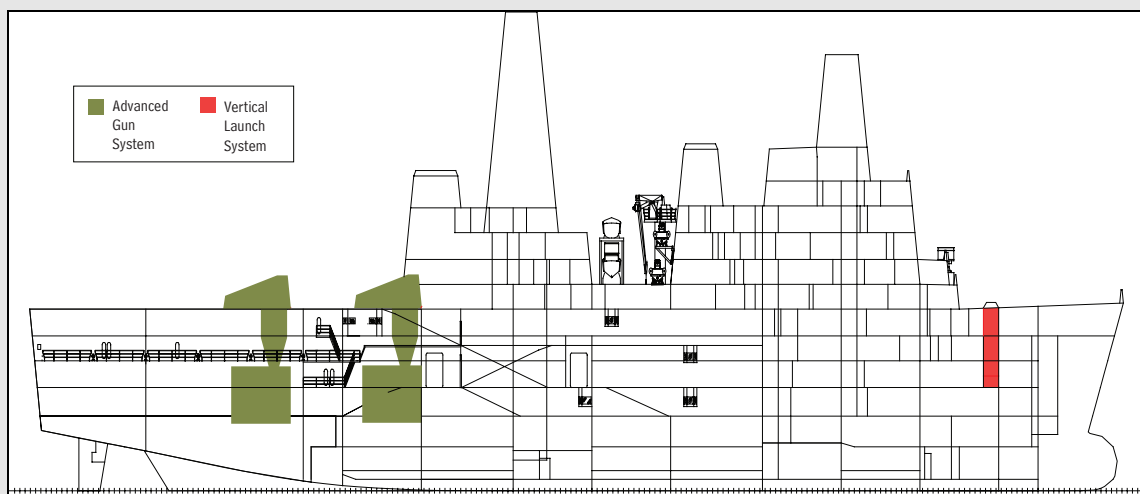
Box 3-1.**Continued**

CBO estimates that such a ship could be built for about \$1.5 billion today, not including about \$400 million for redesigning the appropriate spaces on the LPD-17 hull and for starting what would be, in part, a new class of ship. The average cost for seven fire-support LPD-17s would be about \$1.7 billion, including the real price growth that the naval ship-building industry has been experiencing.

The disadvantage of the fire-support LPD-17 concept is that the result would be not a surface combat-

ant but little more than a gun platform capable of local self-defense. The ship would not have the same degree of stealthiness or aviation capability as a Zumwalt class destroyer, nor would it carry a sophisticated combat suite for operations in contested coastal regions. Such a vessel could really only be used once littoral areas had been made relatively secure by other surface combatants—such as littoral combat ships—so that large, vulnerable amphibious and maritime prepositioning ships could operate relatively close to the shore.

Line Drawing of a Notional LPD-17 Fire-Support Ship with Two AGSs and 16 VLS Cells



\$13.2 billion over the 30-year period, falling to less than \$10 billion by 2035 (see Figure 3-11 on page 55). Aircraft O&S costs would average \$8.2 billion annually. Overall, the total resources needed to buy and operate ships and aircraft under Option 5 would average \$42.6 billion per year.

Steady-State Composition of the Fleet Under Option 5

Emphasizing sea basing within current funding constraints would result in the largest steady-state fleet among the options in this study—241 battle force ships, of which 24 would constitute the MPF(F) squadrons.

However, the Navy would have fewer strike groups than under the other options: a total of 16, comprising seven carrier strike groups and nine expeditionary strike groups.

On paper, three of those groups would contain only two surface combatants rather than three. But because the 45 large surface combatants and fire-support ships would employ rotating crews, providing an amount of presence equivalent to 62 single-crewed ships, each strike group would actually deploy in peacetime with three surface combatants. Moreover, unlike all of the other options and the Navy's current plan, this alternative would provide two sea-basing squadrons.

The Effect of Different Budget Assumptions on the Options

As described above, CBO constrained the options in this analysis to fit within an average annual budget of about \$43 billion (in 2007 dollars) for buying and operating the Navy's ships and aircraft. Whether that represents a reasonable assumption about future budgets will not be clear for some time. Nevertheless, this analysis is applicable to alternative budget levels.

Every \$500 million a year in additional shipbuilding funds would provide a total of \$15 billion over the 30-year period of this analysis. That sum, roughly speaking, could buy *one* of the following over 30 years:

- 1 aircraft carrier and its air wing of 60 planes,
- 5 Virginia class attack submarines (one every six years),
- 4 DDG-1000 Zumwalt class destroyers (one every 7.5 years),
- 4 CG(X) cruisers (one every 7.5 years),
- 30 littoral combat ships (one per year), or
- 1 sea-basing squadron of 12 ships (one ship every 2.5 years).

Likewise, \$500 million less in average annual funding for ship construction would reduce the battle force fleet by a corresponding number of ships.

Comparing the Options by Various Measures of Capability

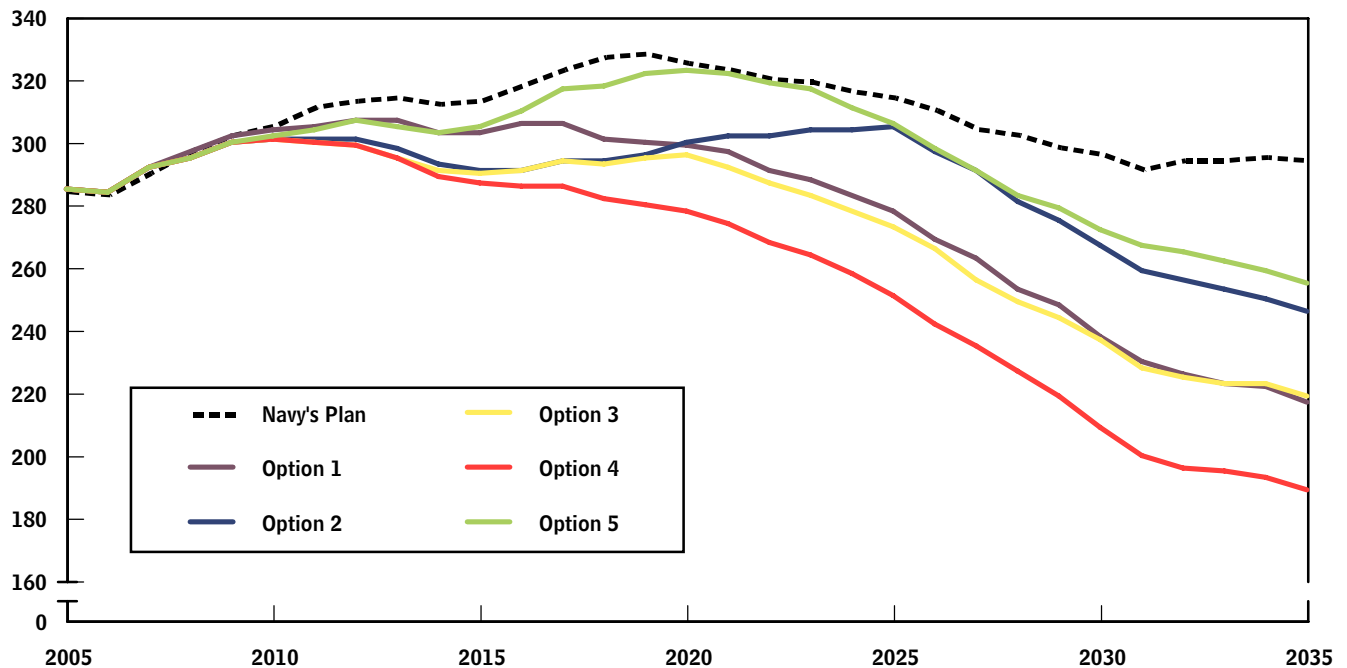
The issue of how to measure naval power—and thus determine how many ships and what kinds of capabilities the United States needs—has been drawing increasing attention from both Navy leaders and the Congress. Navy officials regularly set numerical requirements for ships and at times stress that numbers matter in assessing the strength of the fleet.¹ Other officials and Members of Congress argue that the Navy needs measures besides simple ship counts to gauge its capabilities.² Recently, the Chief of Naval Operations straddled the issue by stating that the current fleet of about 280 battle force ships is too small to provide the capabilities needed over the long term.³

Given the ongoing debate about how best to measure and determine capabilities, the Congressional Budget Office used a variety of metrics to assess how the Navy's 2006 shipbuilding plan and the five options described in

Chapter 3 would affect U.S. naval forces and their ability to carry out missions. Those metrics are:

- Characteristics of the battle force fleet:
 - Total number of battle force ships
 - Total number of strike groups
 - Total full-load displacement of the fleet
 - Average age of battle force ships
 - Total crew size of the fleet
 - Total direct operation and support costs of the fleet
- Measures of wartime and peacetime capability:
 - Number of major combatants providing forward presence
 - Number of helicopter hangars on surface combatants
 - Number of vertical launch system cells on surface ships and submarines
 - Number of covert mission days provided by attack and guided missile submarines
 - Number of targets that can be attacked per day by carrier aircraft
 - Number of guns on battle force ships
- Mobility (the total amount of amphibious and maritime prepositioning lift provided by the fleet)

1. See, for example, "Interview with Chief of Naval Operations Admiral Vernon Clark," *Sea Power* (October 2002). Admiral Clark reiterated that point in his seminal article "Sea Power 21: Projecting Decisive Joint Capabilities," *Proceedings*, U.S. Naval Institute (October 2002), p. 38. That article, along with several others published by the Naval Institute, were put together in a small booklet distributed by the Navy to advertise its ideas. Also see Gopal Ratnam, "U.S. Navy Wrestles with Fleet Size, Abilities," *Defense News* (July 1, 2002).
2. See Christopher J. Castelli, "England Downplays 375-Ship Goal but Says Surface Force Will Grow," *Inside the Navy* (January 19, 2004); Jason Ma, "Talent: Navy, Congress Should Measure Naval Power in a New Way," *Inside the Navy* (January 26, 2004); and Dave Ahearn, "Rumsfeld on Increasing Fleet Size: Capabilities, Not Numbers, Count," *Defense Today* (December 16, 2005).
3. Dave Ahearn, "Adm. Mullen Opposes Navy Fleet Less Than 281 Vessels," *Defense Today* (April 25, 2006); and Chris Johnson, "CNO: Navy Needs Planned Number of Ships to Generate Capabilities," *Inside the Navy* (February 20, 2006).

Figure 4-1.**Number of Battle Force Ships Under Alternative Force Structures**

Source: Congressional Budget Office.

Those metrics are by no means exhaustive, and they do have limitations. For example, although they indirectly measure warfighting capability, they cannot predict how the Navy would actually fare against an opponent in a particular conflict.

Total Number of Battle Force Ships

The first and most obvious way to compare the fleet under different options is to look at the number of battle force ships. Many advocates of the Navy consider the actual size of the fleet to be a crucial measure of its strength and ability to defend U.S. interests around the world. They have expressed concern about the decline in the number of ships since the end of the Cold War. Others have argued that ship counts do not really matter much and may obscure the fact that the Navy is more capable today than it was a decade ago, when it had many more ships.

In all of the alternatives considered in this analysis, the introduction of littoral combat ships in large numbers over the next 10 years would increase the size of the battle force fleet. Currently at 285 ships, it would rise to about 300 by 2009 with the addition of LCSs.

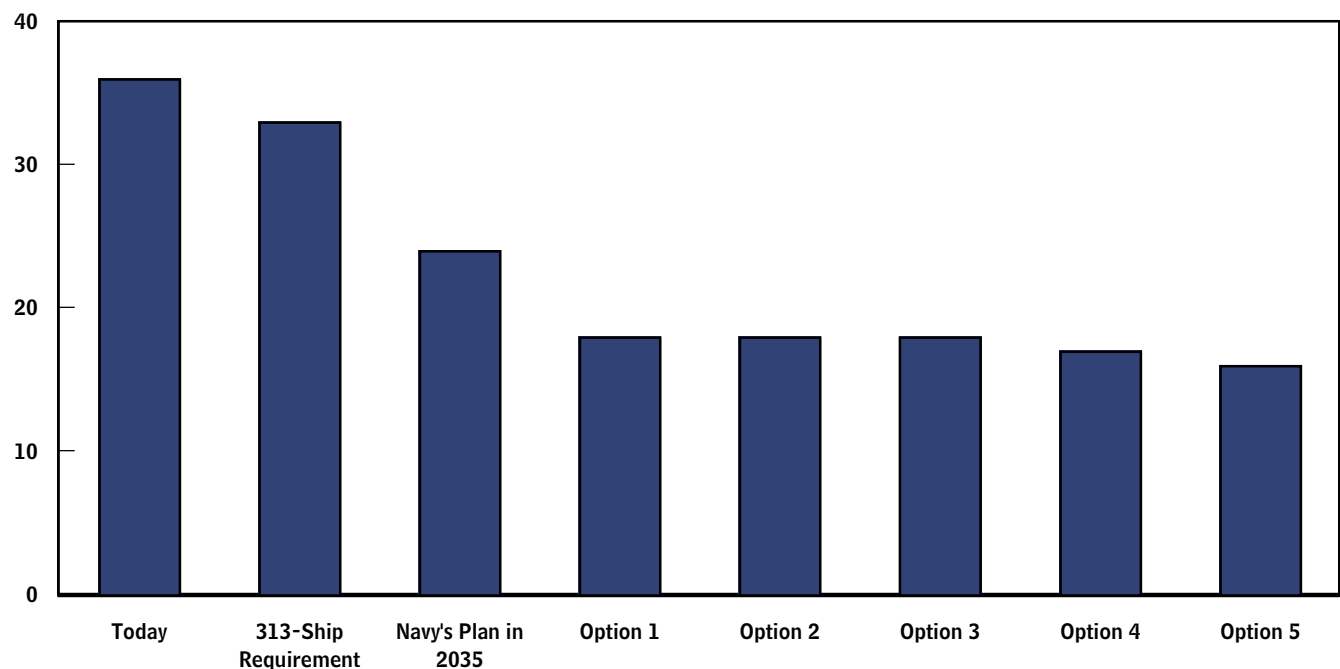
After that, however, the size of the fleet would diverge under the different options (see Figure 4-1). Between 2009 and 2025, Option 5, with its large number of sea-basing ships and 55 LCSs, would produce the largest fleet among the lower-cost alternatives to the Navy's plan. The surface combatant alternative (Option 2) would catch up to it by 2025. Both options would result in a fleet of around 250 ships by 2035. Under the rest of the options, the number of battle force ships would decline steadily after the mid- to late 2010s, ending up at about 190 to 220 ships by 2035. None of the options that CBO considered would sustain a fleet of 250 or more ships much beyond 2035.

Total Number of Strike Groups

Since the introduction of the Global Concept of Operations in 2003, the number of strike groups in the fleet has become a common measure for describing battle force ships. The Navy currently has 36 strike groups (see Figure 4-2). Under the 2006 shipbuilding plan, the service would be reorganized into 33 strike groups, reflecting the reduction of one carrier strike group and two expeditionary strike groups.

Figure 4-2.

Number of Strike Groups Under Alternative Force Structures



Source: Congressional Budget Office.

Notes: The numbers for Options 1 through 5 reflect steady-state levels.

Eleven of the strike groups under Option 3, six under Option 4, and three under Option 5 would contain only two large surface combatants in addition to the other ships.

In practice, however, the number of strike groups would be lower than that because the Navy’s shipbuilding plan would not sustain a fleet of 313 ships after 2030. When the current guided missile submarines retired in the 2020s, they would not be replaced under the Navy’s plan. In addition, the number of large surface combatants would fall to 73 by 2035, compared with the requirement of 88. Those reductions mean that by 2035, the battle force fleet would be organized into 24 strike groups

That number would decline further under the alternatives in this study: to steady-state levels of 18 in the first three options, 17 in the aircraft carrier option (Option 4), and 16 in the sea-basing alternative (Option 5). On paper, 11 of the strike groups in Option 3, six in Option 4, and three in Option 5 would be supported by only two surface combatants rather than the usual three. However, because all large surface combatants are assumed to use Sea Swap crew rotation in these alternatives, each carrier

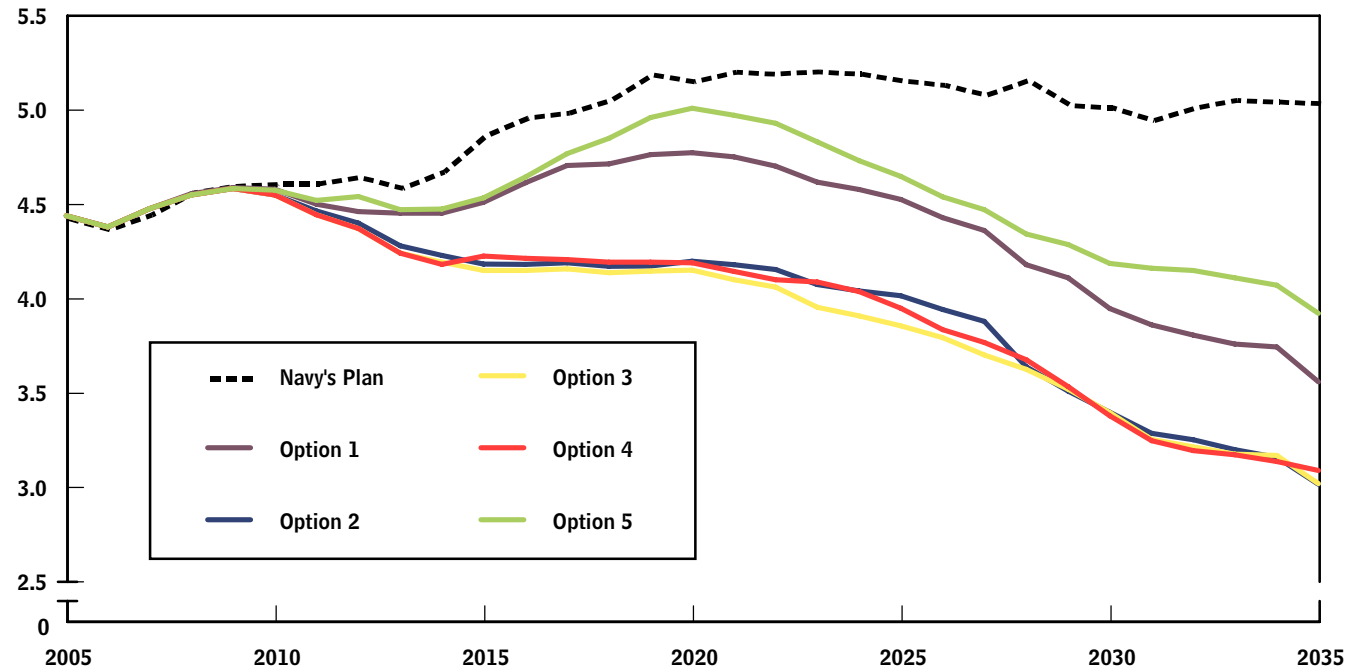
and expeditionary strike group could be supported by three surface combatants when it performed peacetime presence missions.

Moreover, Sea Swap would have a considerable effect on the amount of overseas presence that strike groups could provide in peacetime. Under the Navy’s plan, using Sea Swap on most major surface combatants would allow the Navy to provide peacetime presence equivalent to that of 11 additional surface action groups. Under four of the options that CBO considered, the additional presence would be equivalent to that provided by four to seven surface action groups. (No additional groups would be available under Option 3 because it would have the fewest large surface combatants. In that alternative, Sea Swap would provide just enough peacetime presence so that the 14 carrier and expeditionary strike groups could operate with three surface combatants each.)

Figure 4-3.

Total Full-Load Displacement of Battle Force Ships Under Alternative Force Structures

(Millions of long tons)



Source: Congressional Budget Office.

Total Full-Load Displacement

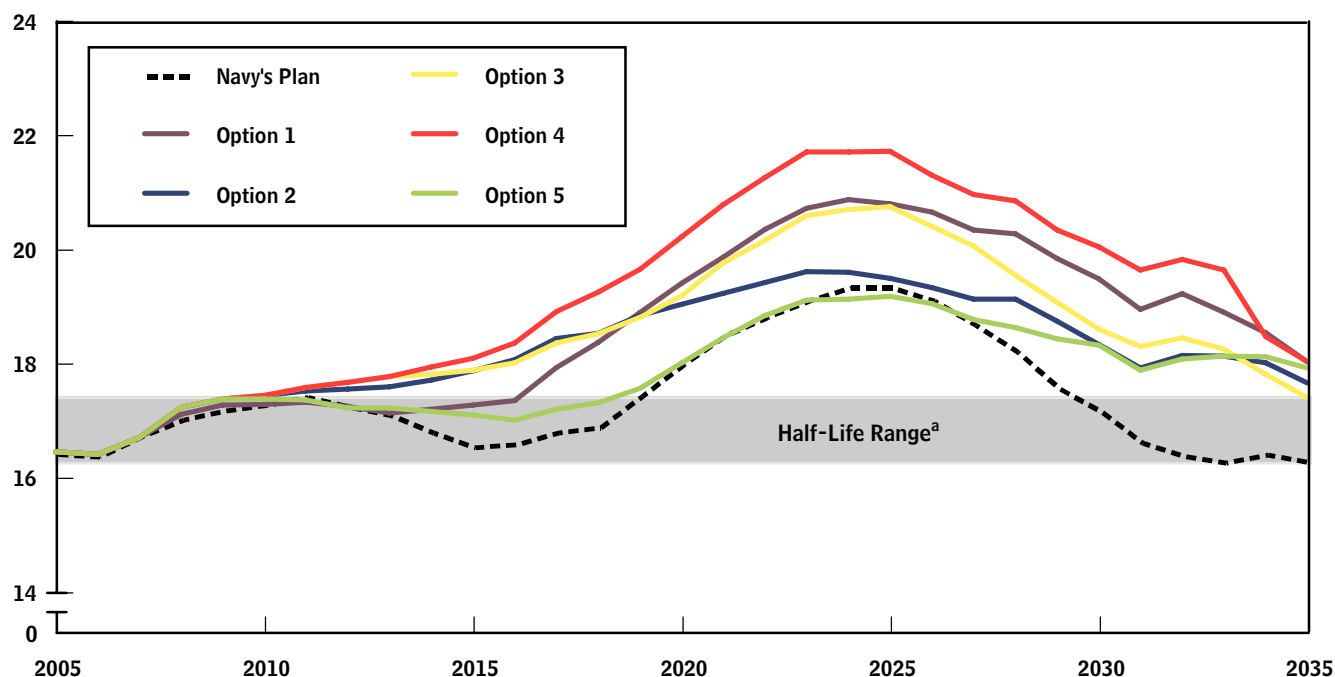
Although not as common a measure as it was in the battleship era before World War II, the total displacement of the Navy's fleet is still used by some analysts to indicate the strength of a given force. For example, in his analyses, Robert Work of the Center for Strategic and Budgetary Assessments notes that the ships of the U.S. Navy have a greater total displacement than the fleets of the 17 next largest navies combined.⁴ (Whereas discussions of ship-building such as those in Chapter 3 and the appendix focus on a vessel's lightship displacement, discussions of capability tend to use full-load displacement, which is the weight of a ship when it is fully equipped and loaded with weaponry, crew, and supplies.)

All of the options described in Chapter 3 would result in a fleet that, by 2035, displaced 0.5 million to 1.5 million

fewer tons than today's Navy—a reduction of between 20 percent and 30 percent (see Figure 4-3). Total displacement would increase through 2010 along with the size of the fleet. But thereafter, displacement would decline under Options 2, 3, and 4 as older ships left the fleet in the 2020s and 2030s and were not replaced. Under the other options and the Navy's plan, total displacement would increase until 2020 and then start to decline. Only the Navy's plan would result in a fleet with roughly the same displacement in 2035 as the current fleet.

The five options would end the 30-year period within about 900,000 tons of each other in terms of displacement, suggesting a rough comparability that reflects the fact that they share the same budgetary constraint. Even that range can be misleading, however. The heaviest and largest fleet in 2035 would be that of Option 5, with its two sea-basing-capable MPF(F) squadrons. One of the lightest and smallest fleets would be the submarine-focused force of Option 3. If, in a hypothetical world, those two fleets fought each other, the numerous stealthy

4. Dave Ahearn, "Navy Needs Enough Ships, but Capability Is Key," *Defense Today* (December 20, 2004).

Figure 4-4.**Average Age of Battle Force Ships Under Alternative Force Structures**

Source: Congressional Budget Office.

- a. The half-life is the midpoint in a fleet's notional service life. An average age well above the half-life generally implies that many ships may soon have to be replaced or refurbished over a short period to prevent the size of the fleet from declining. CBO calculated a half-life for each option's fleet based on the weighted average of the expected service lives of the ships in that fleet. For the five options and the Navy's plan, half-lives range from 16.3 years to 17.4 years.

submarines of Option 3 would undoubtedly overwhelm the slow-moving, relatively vulnerable amphibious and MPF(F) ships of Option 5. That outcome illustrates the potentially limited utility of total displacement as a measure of capability.

Average Ship Age

The average age of the Navy's current battle force ships is 16.4 years—about one year shy of the halfway point in that fleet's notional service life of 35 to 36 years. (The halfway point is referred to in this analysis as the half-life.) With any inventory, an average age well above the half-life generally implies that many pieces of equipment may soon have to be replaced or refurbished over a short span of time to prevent the inventory from shrinking.

All of the options that CBO examined would result in a much higher average ship age during more than 15 years of the projection period, exceeding the half-lives of their

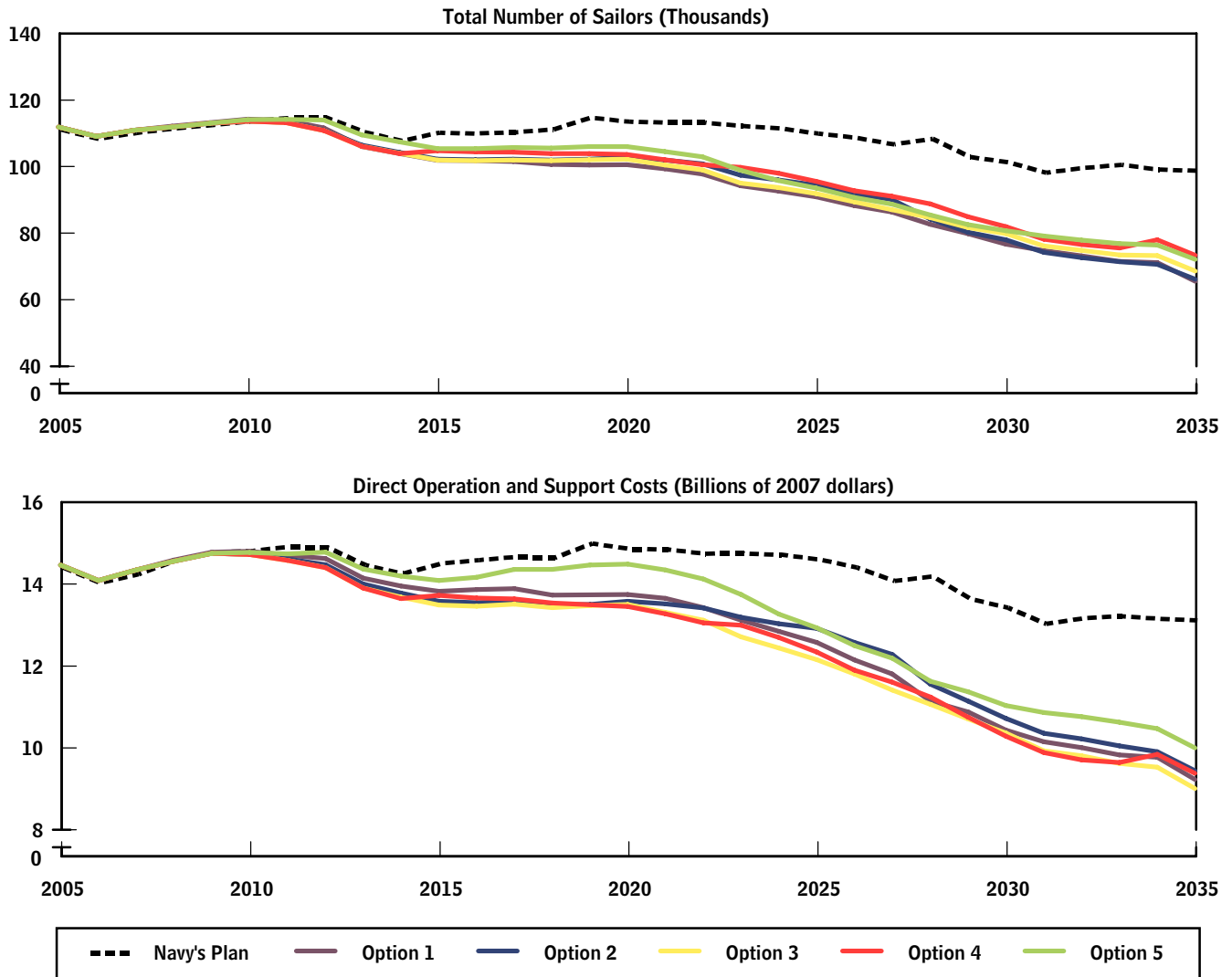
respective fleets by several years (see Figure 4-4).⁵ By 2035, however, average ages would return to levels only slightly higher (0.5 to 1.5 years) than the relevant half-lives.

Specifically, the surface combatant and submarine alternatives (Options 2 and 3) would produce the youngest fleets in 2035, with average ages of 17.6 and 17.4 years, respectively. Options 1 and 4's fleets would be the oldest at 18.0 years—only 5 percent higher than those fleets' half-lives. The Navy's plan, with the largest number of ship purchases over the 2006-2035 period, would result in a slightly younger fleet than exists now, with an average age of 16.3 years.

5. CBO calculated a half-life for each option's fleet based on the weighted average of the expected service lives of the ships in that fleet. For the five options and the Navy's plan, half-lives range from 16.3 years to 17.4 years.

Figure 4-5.

Total Crew Size and Direct Operating Costs of Battle Force Ships Under Alternative Force Structures



Source: Congressional Budget Office.

Note: Direct operation and support costs are those directly related to the number of ships in the fleet (such as costs for fuel, supplies, and compensation of personnel).

Total Crew Size and Direct Operation and Support Costs

Although crew size and operating costs are not indicators of capability, they are measures of great concern to the Navy. Addressing the rising costs of military personnel—which claim about 30 percent of the Navy’s budget (with all benefits taken into account)—has become a top priority of Navy leaders. Their emphasis on designing and building ships that can be operated with far fewer crewmembers is aimed at reducing military personnel costs across the fleet. Reducing those costs would in turn lower direct operation and support costs (which also include ship maintenance).⁶

By decreasing the size of the battle force fleet, the options in this analysis would substantially reduce the total number of sailors needed and the fleet’s direct O&S costs (see Figure 4-5). Today, the Navy employs about 109,000 men and women to crew its battle force ships and incurs about \$14 billion a year in direct operation and support costs. The Navy’s 2006 shipbuilding plan would eliminate the need for about 10,000 crew members and would lower annual O&S costs to \$13.1 billion by 2035. By comparison, the options that CBO considered would reduce total crew size by 33 percent to 40 percent (or by 36,000 to 43,000 sailors) and would reduce direct O&S costs by 29 percent to 36 percent (to \$10 billion per year or less).

Number of Major Combatants Providing Forward Presence

Since the end of the Cold War, the number of ships that the Navy keeps deployed around the globe has become an important measure. The quantity of ships on-station in operating areas overseas at any given time represents the nation’s naval crisis-response capability. How many ships are already on the scene or within several days’ steaming distance will determine how well the Navy deals with a humanitarian disaster or an international conflict.

As discussed in Chapter 1, the Navy is experimenting with crew rotation concepts such as Sea Swap and looking for ways to base more ships overseas. Those efforts indicate the importance that senior Navy leaders attach to increasing forward presence.

In its analysis, CBO compared the amount of forward presence provided by the Navy’s major combatants—a category that includes littoral combat ships and MPF(F) squadrons but excludes logistics and support ships. It also excludes ballistic missile submarines because they do not need to be forward deployed to perform their mission, given the long range of the nuclear missiles that they carry. Moreover, it would not be desirable to have ballistic missile submarines operate close to potential enemies’ operating areas because that would unnecessarily increase their vulnerability to detection and attack in the event of a war.

CBO assumed that major surface combatants (except Ticonderoga class cruisers and Oliver Perry class frigates) would employ Sea Swap by 2012 and that the Navy would base nine submarines in Guam by that year. All other ships were assumed to operate as they do today. Ships based overseas, such as the carrier and expeditionary strike groups in Japan as well as the MPF(F) squadrons, count as forward deployed all of the time.

Under those assumptions, the Navy’s current plan—with its much bigger and more expensive force—would provide the largest amount of forward presence by major combatants through 2020 (see Figure 4-6). The sea-basing alternative (Option 5) would provide more presence than the Navy’s plan after 2021 because of its second MPF(F) squadron. Option 2, with its emphasis on surface combatants, would provide the next largest amount of forward presence. The carrier alternative (Option 4), which would have the smallest combat fleet, would provide the least amount of presence. However, that option would keep the same number of carrier strike groups overseas as the Navy’s plan, something no other alternative would be able to do.

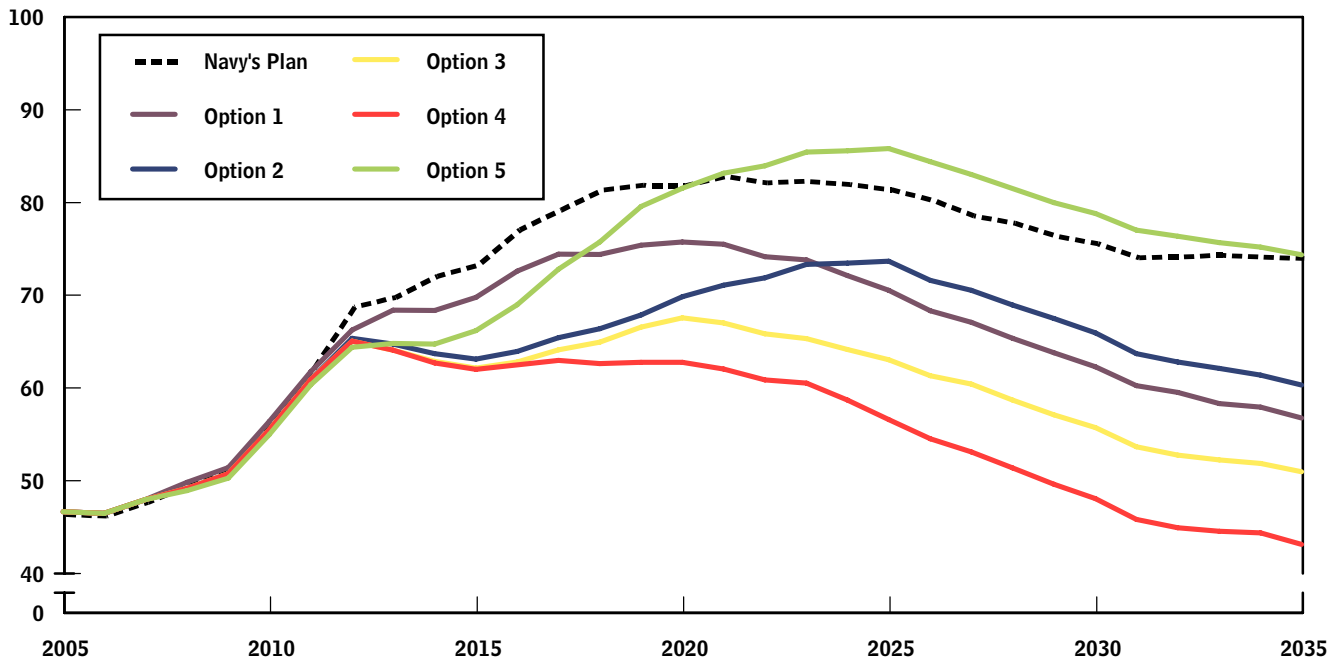
Number of Helicopter Hangars

As described in Chapter 1, among the threats that concern naval planners are quiet diesel-electric submarines, mines, and small fast boats armed with torpedoes or cruise missiles that would make it hard for the Navy to operate in a particular area. Generally, one of the most

6. CBO defines direct O&S costs as ones that are directly associated with operating a ship, such as the costs of salaries and benefits for the crew; fuel, food, and other consumable goods; and maintenance performed onboard the ship. Indirect O&S costs, which are not included in this analysis, may include the costs of infrastructure at maintenance facilities, personnel not serving on a ship, and other items.

Figure 4-6.

Number of Major Combatants Providing Forward Presence Under Alternative Force Structures



Source: Congressional Budget Office.

Note: Major combatants are aircraft carriers, amphibious and Maritime Prepositioning Force (Future) ships, attack submarines, large surface combatants, and littoral combat ships. The figure excludes support ships and ballistic missile submarines.

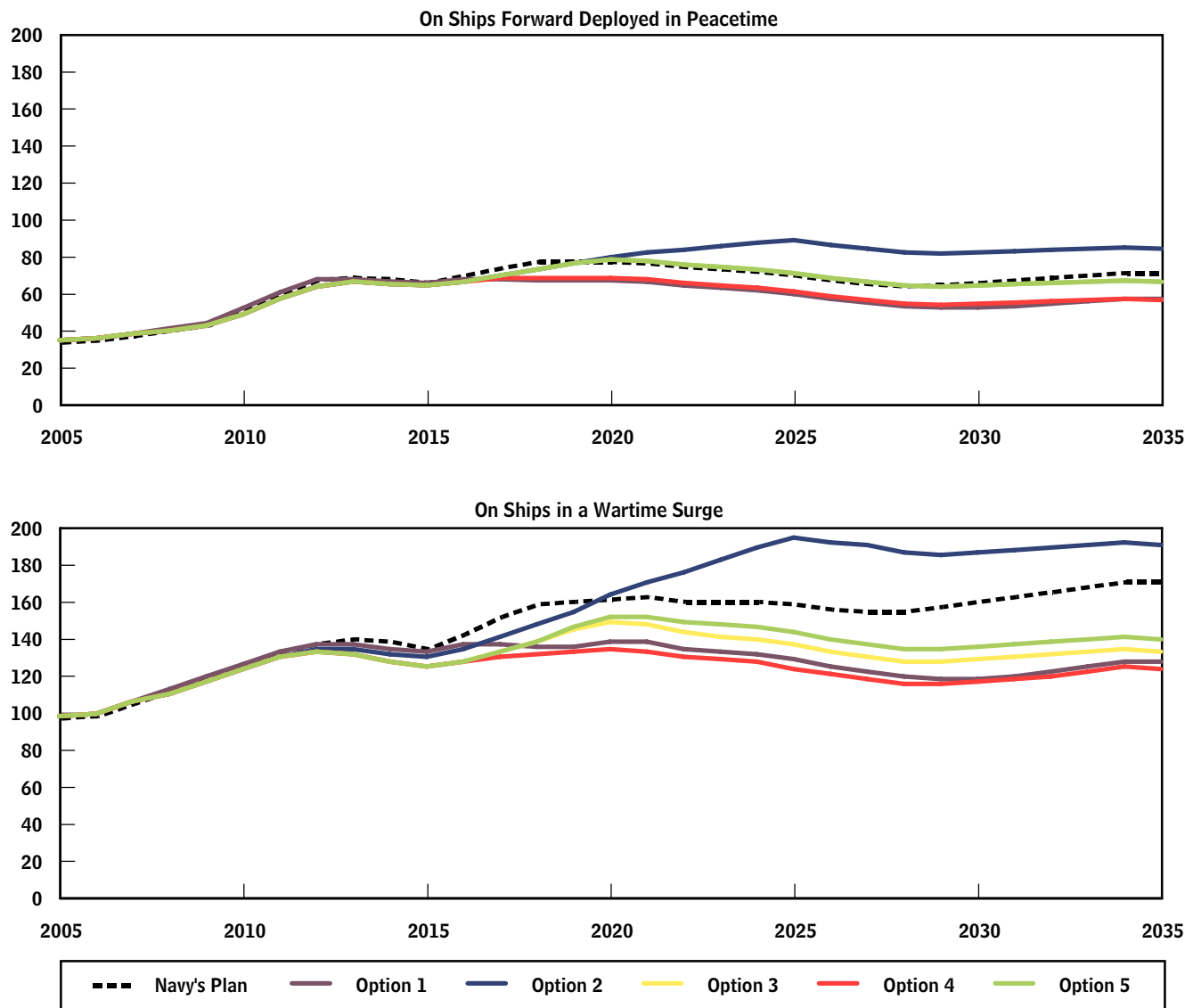
effective weapons to detect and target such antiaccess threats is helicopters. Counting the number of helicopter hangars on surface ships indicates the number of helicopters that the Navy could use to counter such threats. The more hangars available in peacetime or during a war, the more flexible and better equipped the surface combatant force will be.

Because this measure is important in both peacetime and wartime, CBO compared the number of helicopter hangars on surface combatants that would be forward deployed at a given time as well as the number on ships that could be surged to a theater within 90 days during wartime. (In general, only 20 percent to 25 percent of the fleet is deployed overseas at any one time, and just 5 percent to 10 percent may be on-station in a particular theater of operations. In the event of a war, however, between one-half and two-thirds of the fleet could be mustered in 30 to 90 days, if necessary.)

Today's fleet of surface combatants contains a total of about 150 helicopter hangars. Of those, about 35 are forward deployed at any given point in peacetime, and about 100 could be surged in the event of a war (see Figure 4-7). All of the options in this analysis would increase those numbers by 2035 by introducing large numbers of littoral combat ships, which have two helicopter hangars apiece. The surface combatants in Option 2 would provide the largest numbers of hangars in peacetime (84) or wartime (190). By comparison, the Navy's plan would keep 72 hangars forward deployed at any given time and could surge 172 in the event of a crisis. The alternative that would make across-the-board cuts (Option 1) and the 11-carrier force (Option 4) would have the smallest numbers of helicopter-carrying surface combatants. By 2035, those options would have about 55 hangars on forward-deployed ships in peacetime and could surge about 125 in the event of a war.

Figure 4-7.

Number of Helicopter Hangars on Surface Combatants Under Alternative Force Structures



Source: Congressional Budget Office.

Number of Vertical Launch System Cells

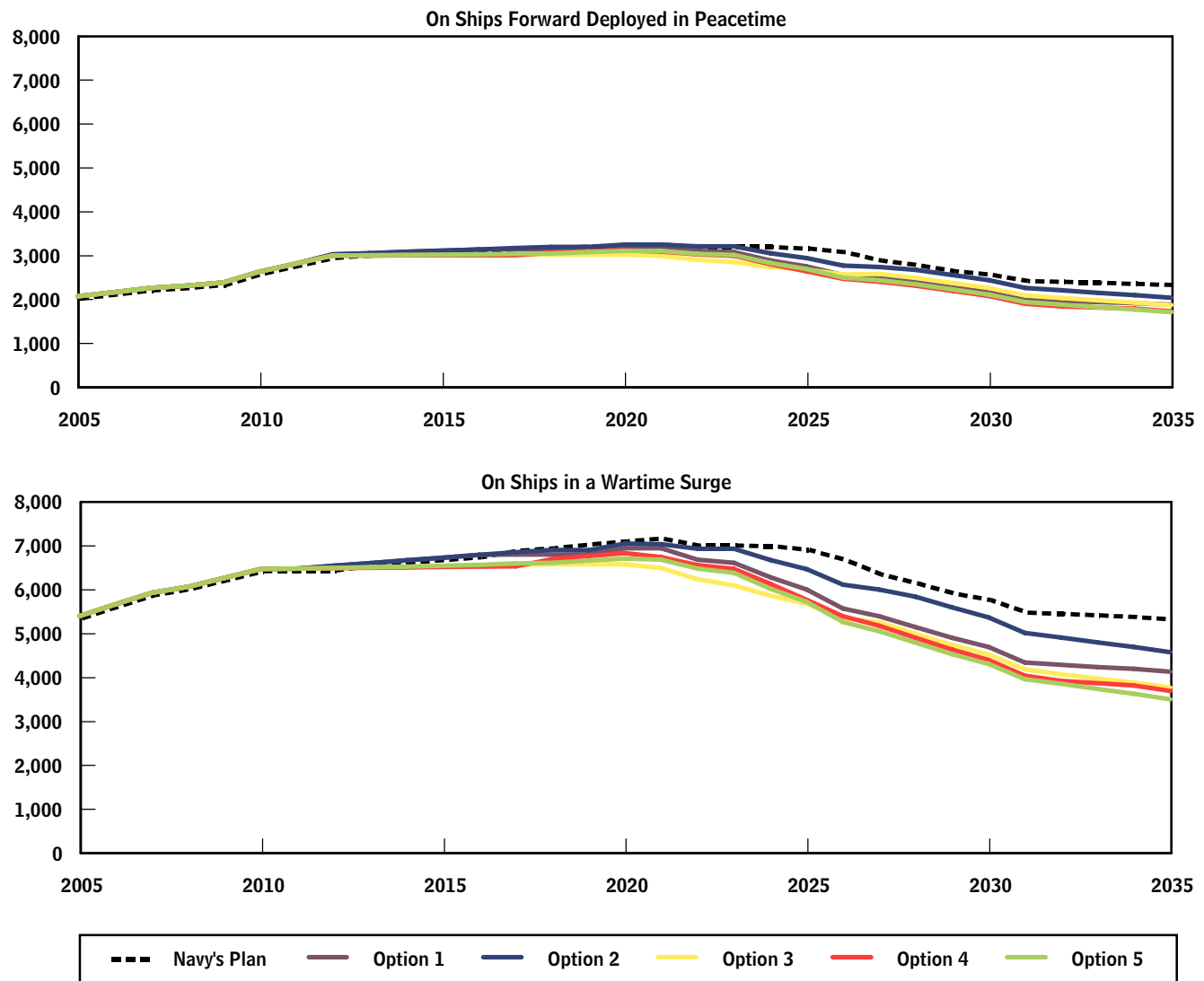
The development and deployment of VLS cells have played an important role in increasing the long-range capability of surface ships and attack submarines. In peacetime, the Navy's regional combatant commanders require a certain number of Tomahawk missiles to be on-station in their respective theaters. Those Tomahawks would

usually be launched from VLS cells (although not every cell on a surface ship is filled with land-attack missiles). Thus, the total number of VLS cells can be used to approximate how well a force structure would meet those peacetime requirements.

The number of VLS cells that are on-station overseas in peacetime or that can be surged to a theater of operations in a war is governed by the total number in the force

Figure 4-8.

Number of VLS Cells on Surface Combatants and Attack Submarines Under Alternative Force Structures



Source: Congressional Budget Office.

Note: VLS = vertical launch system.

and how that force is employed. That in turn determines the ability of surface combatants and submarines to conduct long-range strike operations in support of military objectives.

The ships in today's fleet have approximately 8,000 VLS cells in all. Of those, about 2,100 are on-station at any given time, and 5,600 could be surged in a crisis. Those numbers would be higher through 2025 under all of the options in this analysis as well as the Navy's shipbuilding

plan (see Figure 4-8). The largest increase would occur under the Navy's plan (to a peacetime presence of about 3,300 cells and a wartime surge of 7,200 cells in 2021), and the smallest increases would occur under the submarine, carrier, and sea-basing alternatives (to about 3,000 cells on-station in peacetime during that year and 6,500 to 6,900 in a wartime surge). By the early 2020s, however, the retirement of Ticonderoga class cruisers, which have 120 VLS cells each, and the decline in the number of attack submarines (except under Option 3) would

begin to steadily reduce the number of VLS cells in the fleet under all alternatives. That decline would accelerate in the mid-2020s when Arleigh Burke class destroyers, which have 90 to 96 VLS cells apiece, were retired faster than they would be replaced.

By 2035, however, the Navy's plan would result in nearly 900 fewer VLS cells overall than today's force has, although about the same numbers deployed in peacetime or wartime. Option 2, with 64 VLS-capable surface combatants and around 30 attack submarines still in the fleet, would have more than 6,400 cells in total, resulting in about 2,000 cells on-station in peacetime (as today) but 4,600 cells in a wartime surge. Option 5, with its emphasis on sea basing, would provide a total of only about 5,200 cells, for a peacetime presence of 1,700 cells and a wartime surge of 3,500 cells (just three-fifths of today's level). The remaining alternatives would be in between Options 2 and 5.

Covert-Mission Days Provided by Submarines

The principal peacetime role of attack submarines is to conduct reconnaissance and intelligence-collection missions. To measure the relative capabilities of the SSN force in this analysis, CBO used the number of covert-mission days that the force could carry out in a year, on average. According to a 1999 study by the Chairman of the Joint Chiefs of Staff, an attack submarine based in the United States provides an average of 36 covert-mission days per year over its service life. As mentioned above, CBO assumed that the Navy would have nine attack submarines stationed in Guam by 2012. By being closer to their operating areas and using a different deployment concept, submarines based in Guam can provide more than twice as many mission days as submarines based in the continental United States.⁷ In addition, CBO's calculations included the mission days that could be provided by guided missile submarines.

Today's fleet, including the four SSGNs, can provide a total of about 2,700 covert-mission days per year (see Figure 4-9). That number would increase over the next 10 years under the Navy's plan and all of the alternatives

as six more submarines were gradually transferred to Guam. After 2015, however, the retirement of large numbers of Los Angeles class submarines would reduce the size of the attack submarine force because replacements would not be built quickly enough to offset the retirements.

Apart from that common increase and then decrease, the options and the Navy's plan differ substantially in terms of covert-mission days. Option 3—with its emphasis on attack submarines, including maintaining the SSGNs—would yield the largest number of covert-mission days throughout the 30-year period of this analysis. Like the others, that option would see a decline in the 2020s from submarine retirements, but by 2035 it would rebound to provide around 3,100 mission days. The Navy's plan, by comparison, would provide about 2,400 covert-mission days that year. The surface combatant, carrier, and sea-basing alternatives (Options 2, 4, and 5) would provide the fewest mission days in 2035—around 1,700—because of the relatively small number of submarines in their fleets.

Targets Attacked per Day by Carrier-Based Aviation

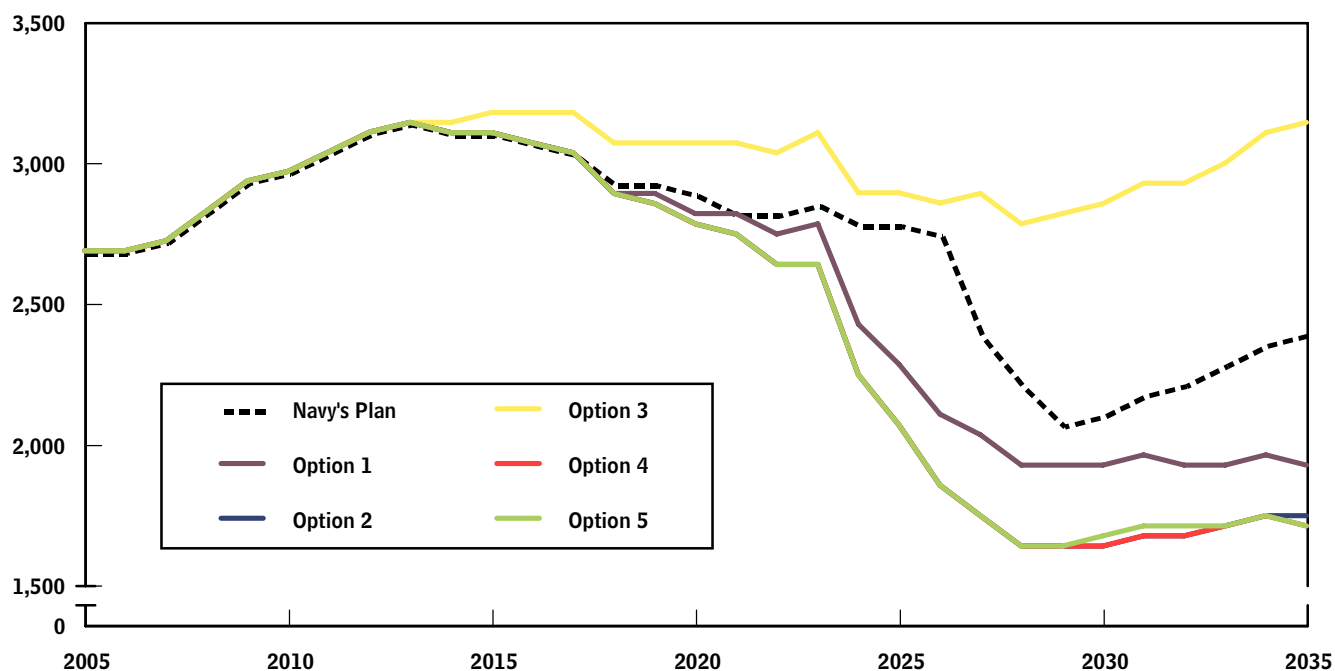
One measure of fleet capability that the Navy has stressed repeatedly in recent years is the number of targets that can be attacked (or "serviced") each day by planes launched from aircraft carriers. With the introduction and widespread use of precision munitions, such as the Joint Direct Attack Munition, one Navy aircraft equipped with four such munitions could successfully hit and destroy four different targets. The Navy has said on numerous occasions that the metric has changed since the 1980s from "sorties per target" to "targets per sortie."

Furthermore, the Navy has asserted in reports to the Congress that the new CVN-21 class of aircraft carriers will be able to launch 160 strike sorties per day for a 30-day period, an increase of about 30 percent from today's level. (That figure assumes that the carrier conducts flight operations for 12 hours per day, with the other 12 hours used to rest personnel and equipment.) The increase in sorties depends in large measure on the new capabilities planned for the CVN-21, such as an electromagnetic catapult, as well as on a redesign of the traditional carrier

7. See Congressional Budget Office, *Increasing the Mission Capability of the Attack Submarine Force* (March 2002).

Figure 4-9.

Total Covert-Mission Days Provided by the Attack Submarine Force Under Alternative Force Structures



Source: Congressional Budget Office.

flight deck and aircraft elevators to allow faster maintenance and rearming.⁸

In using the metric of number of targets attacked to compare fleets, CBO assumed that the higher sortie rate of the new CVN-21s would be realized and that each aircraft would be armed with four precision munitions. (In the future, the introduction of new weapons, such as the small-diameter bomb being developed by the Air Force, might increase the number of targets attacked because each aircraft could carry more of such weapons.) Further, CBO assumed that Nimitz class carriers or others would be able to sustain 140 sorties per 12-hour day (a rate the Navy expects to achieve by 2010), also with four weapons and thus four potential targets per sortie. All of the carriers were assumed to operate according to the time lines of the Fleet Response Plan, which asserts that two-thirds of

the carrier force could be deployed to a theater of operations within 90 days.

Under those assumptions, the current carrier force, with 10 deployable air wings, could strike about 3,500 targets per day (see Figure 4-10). With the addition of CVN-21s, the 11 carriers and 10 air wings of Option 4 and the Navy's plan would be able to strike nearly 4,200 targets per day by 2035. The seven deployable air wings in Option 3 would be able to strike about 2,900 targets per day by that year. However, the rest of the alternatives—which would maintain only six deployable air wings and delay the introduction of CVN-21s by 20 years—would be able to strike only about 2,300 targets per day by 2035.

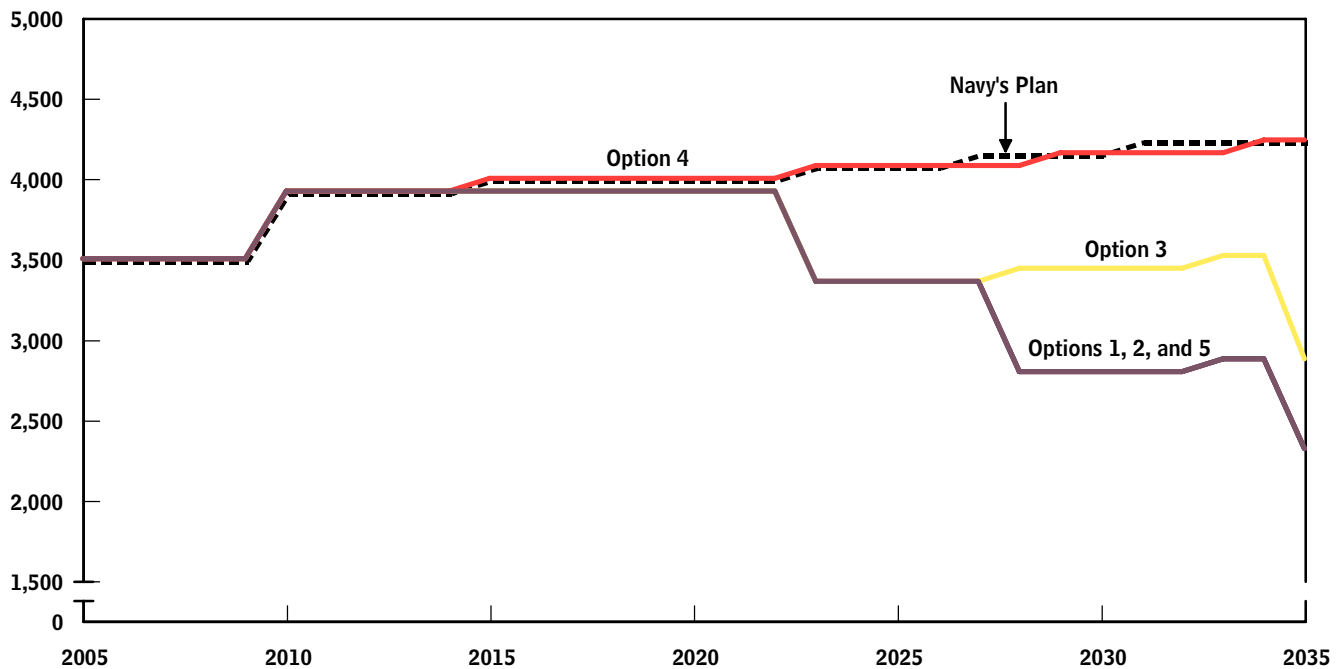
Naval Surface Fire Support

The amount of firepower that the Navy's surface combatants could deliver in a combat situation is a seldom-used measure. But it could become more important depending on the course of the future security environment. To

8. See Benjamin S. Lambeth, *American Carrier Air Power at the Dawn of a New Century* (Santa Monica, Calif.: RAND Corporation, 2005); and Owen R. Cote Jr., *The Future of Naval Aviation* (Cambridge, Mass.: MIT Security Studies Program, 2006).

Figure 4-10.

Number of Targets Attacked per Day by Carrier Aircraft Under Alternative Force Structures



Source: Congressional Budget Office.

Note: This figure assumes that under the Fleet Response Plan, the Navy could deploy eight carriers out of a fleet of 12 to a theater of operations in 90 days, seven carriers out of a fleet of 11, six carriers out of a fleet of nine or 10, and five carriers out of a fleet of seven or eight.

measure that firepower, CBO looked at both the number of guns on surface combatants that could be surged to a theater in wartime and the magazine capacity available at the outset of a conflict. (Magazines could be resupplied from support ships in three to 18 hours depending on the circumstances of the operation.) For this metric, which is primarily a wartime measure, CBO assumed that about two-thirds of the Navy's surface combatants would be surged to support a combat operation.

Most of today's large surface combatants are equipped with 5-inch, 54-caliber guns that can hit targets up to 13 nautical miles away. With the launch of DDG-81 in 2001, the Navy began equipping its destroyers with 5-inch, 62-caliber guns that will be able to fire Extended Range Munitions (ERMs), which are now under development. Those munitions are rocket-assisted projectiles that are intended to reach 63 nautical miles. The Navy's planned DDG-1000 Zumwalt class destroyers are expected to carry Advanced Gun Systems that have a range

of 83 nautical miles and three times the payload of 5-inch guns.⁹ Consistent with the Navy's 2006 shipbuilding plan, CBO assumed that the new CG(X) cruiser would not carry guns, although a final decision on that issue has not been made.¹⁰

The size of gun magazines also varies by ship depending on how the ship is loaded. For example, Arleigh Burke

9. Eighty-three nautical miles is the maximum range of the Advanced Gun System. If the Navy wanted to have numerous shells from the same ship land simultaneously—as it sometimes discusses—the effective range would be much shorter because of the need for different trajectories to create that effect. Shells with higher trajectories take more time to reach their targets and thus would be fired before shells with lower trajectories to ensure that all of them arrived at the same time.

10. See Department of the Navy, Office of the Chief of Naval Operations, Director of Surface Warfare, *Report to Congress on Naval Surface Fire Support* (March 2006), Appendix B, "Commandant of the Marine Corps' Views and Recommendations."

class destroyers numbered DDG-81 and higher can be fully loaded with 636 rounds of the conventional 5-inch, 54-caliber munition, or with 232 ERMs and 225 conventional shells for what is called a maximum ERM loadout. The regular magazine for Zumwalt class destroyers is expected to hold 600 Long Range Attack Projectiles.¹¹ For its analysis of firepower at a range of 13 nautical miles, CBO assumed that all Arleigh Burke class destroyers would carry conventional 5-inch munitions. For its analysis at longer ranges, CBO assumed that Arleigh Burke and Zumwalt magazines would hold the maximum number of long-range munitions.¹²

Currently, the Navy has a relatively large capability to provide gunfire support over very short distances. The surface combatants that could be deployed in the event of a conflict carry a total of 63 guns, which have a range of 13 nautical miles. (Although 12 of those ships have 5-inch, 62-caliber guns, the Navy has not yet produced the long-range munitions for them.). Under the 2006 shipbuilding plan, the Navy would have 41 guns at either 13 or 63 nautical miles in 2035 and 10 guns at 83 nautical miles (see Figure 4-11). Total magazine capacity in 2035 would be 23,000 shells at 13 nautical miles, 10,000 shells at 63 nautical miles, and 3,000 shells at 83 nautical miles (see Figure 4-12).

Of the alternatives that CBO considered, Options 2 and 5—which would have the same number of Advanced Gun Systems as the Navy's planned fleet—would provide 35 to 43 guns at 13 or 63 nautical miles in 2035 and 10 guns at 83 nautical miles. At the low end would be Options 3 and 4, which have no Advanced Gun Systems and small numbers of large surface combatants. Those options' surface combatants would be able to deploy 29 guns at 13 or 63 nautical miles but none at 83 nautical miles. The results for magazine capacity would be similar, although the LPD-17 fire-support ships in Option 5 would have larger magazines than the Zumwalt destroyers (by 300 shells).

11. To reduce costs, the Navy has eliminated a storeroom that could have been converted to hold 328 additional rounds.

12. Another factor affecting firepower during a conflict is that when ships' gun barrels wear out, they must be replaced in port; they cannot be replaced at sea. The Advanced Gun System has a barrel life of about 3,000 rounds; the 5-inch, 62-caliber guns, 1,500 rounds; and the conventional 5-inch, 54-caliber guns, 8,000 rounds.

Total Amount of Lift on Amphibious and Maritime Prepositioning Ships

The key measure for transporting and sustaining Marine Corps units in naval expeditionary operations is the total lift for troops and equipment provided by the Navy's amphibious warfare and maritime prepositioning forces. Currently, that total transport capacity is equal to 5.1 Marine expeditionary brigades (MEBs)—2.1 on amphibious warfare ships and 3.0 on conventional maritime prepositioning ships. Until recently, the Navy's goal for such lift was 5.5 MEBs, and the Marine Corps desired 6.0 MEBs (3.0 of amphibious lift and 3.0 of conventional prepositioning lift).

As it introduces sea basing, the Navy is rethinking how much lift it needs and how much it can afford. A squadron of MPF(F) ships would provide 1.0 MEB's worth of lift. But that squadron would be more flexible and closer in capability to an amphibious task force (with one MEB embarked) than to a conventional maritime prepositioning squadron, which would have to use port facilities to unload its equipment. Under the 2006 shipbuilding plan, the Navy would have a total of about 4.0 MEBs' worth of lift: 2.0 MEBs on amphibious ships, 1.0 on the new MPF(F) squadron, and 1.0 on an existing conventional maritime prepositioning squadron. Once it completes operations in Iraq, the Marine Corps does not anticipate having enough sets of equipment available for afloat prepositioning to support more than two Marine expeditionary brigades.

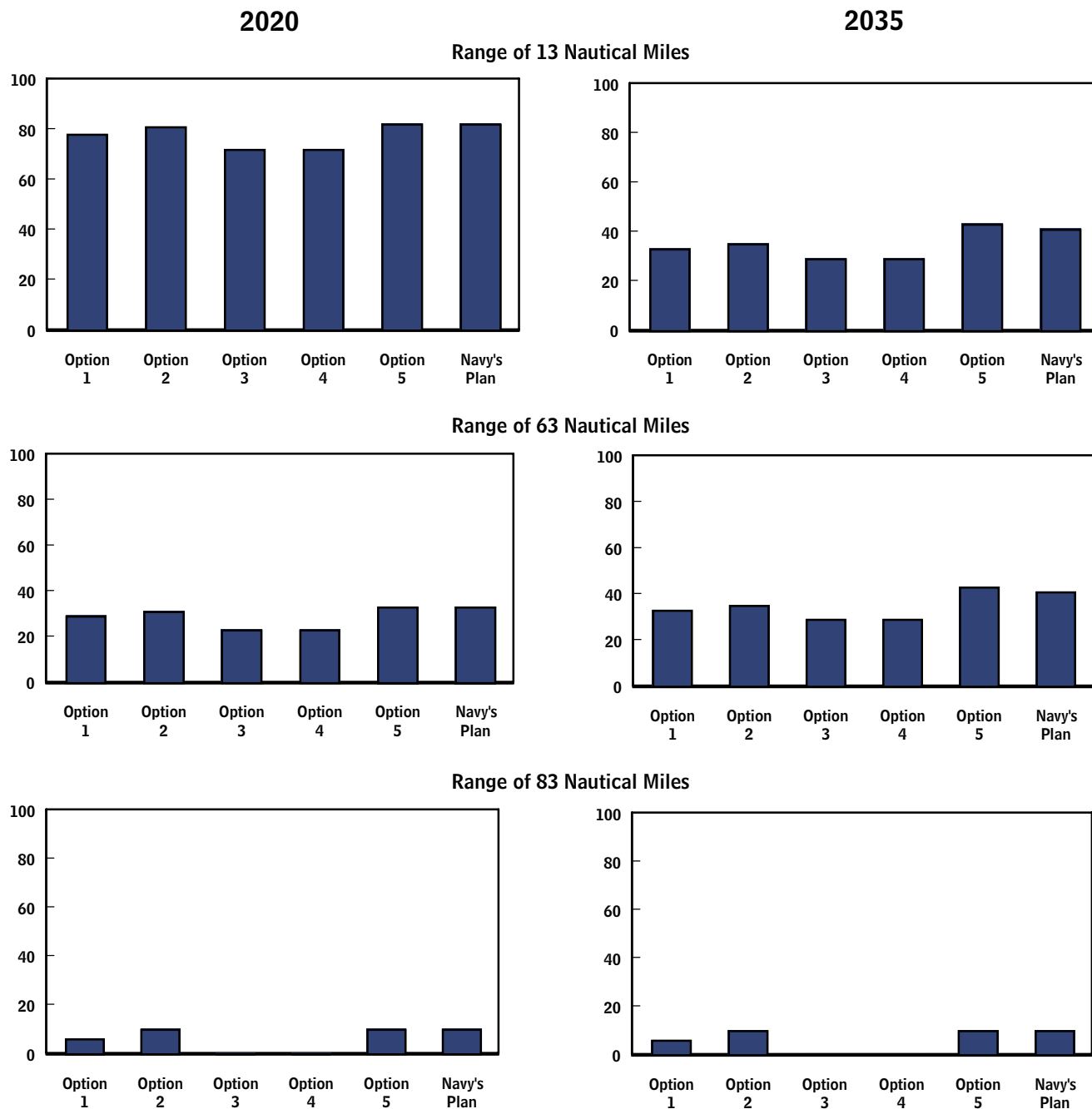
Of the options in this analysis, the sea-basing alternative (Option 5) would provide the most lift by 2035, 3.3 MEBs (see Figure 4-13). Option 1, which would make across-the-board reductions in the fleet, would be next with 3.2 MEBs. However, whereas Option 5's lift capability would be provided entirely by amphibious warfare ships or sea-basing-capable MPF(F) ships, Option 1's total includes 1.0 MEB transported by conventional maritime prepositioning ships. With two sea-basing squadrons and the ability to surge one-half to two-thirds of its amphibious ships, Option 5 could muster nearly 3.0 MEBs to conduct an opposed amphibious assault. Option 1, in comparison, would be able to generate only a little less than 2.0 MEBs to support such an assault.

The surface combatant, submarine, and aircraft carrier alternatives (Options 2, 3, and 4) would effectively end the Navy's ability to conduct a forcible-entry operation.

Figure 4-11.

Amount of Gunfire Support That Could Be Surged to a Theater of Operations in Wartime Under Alternative Force Structures

(Number of guns)

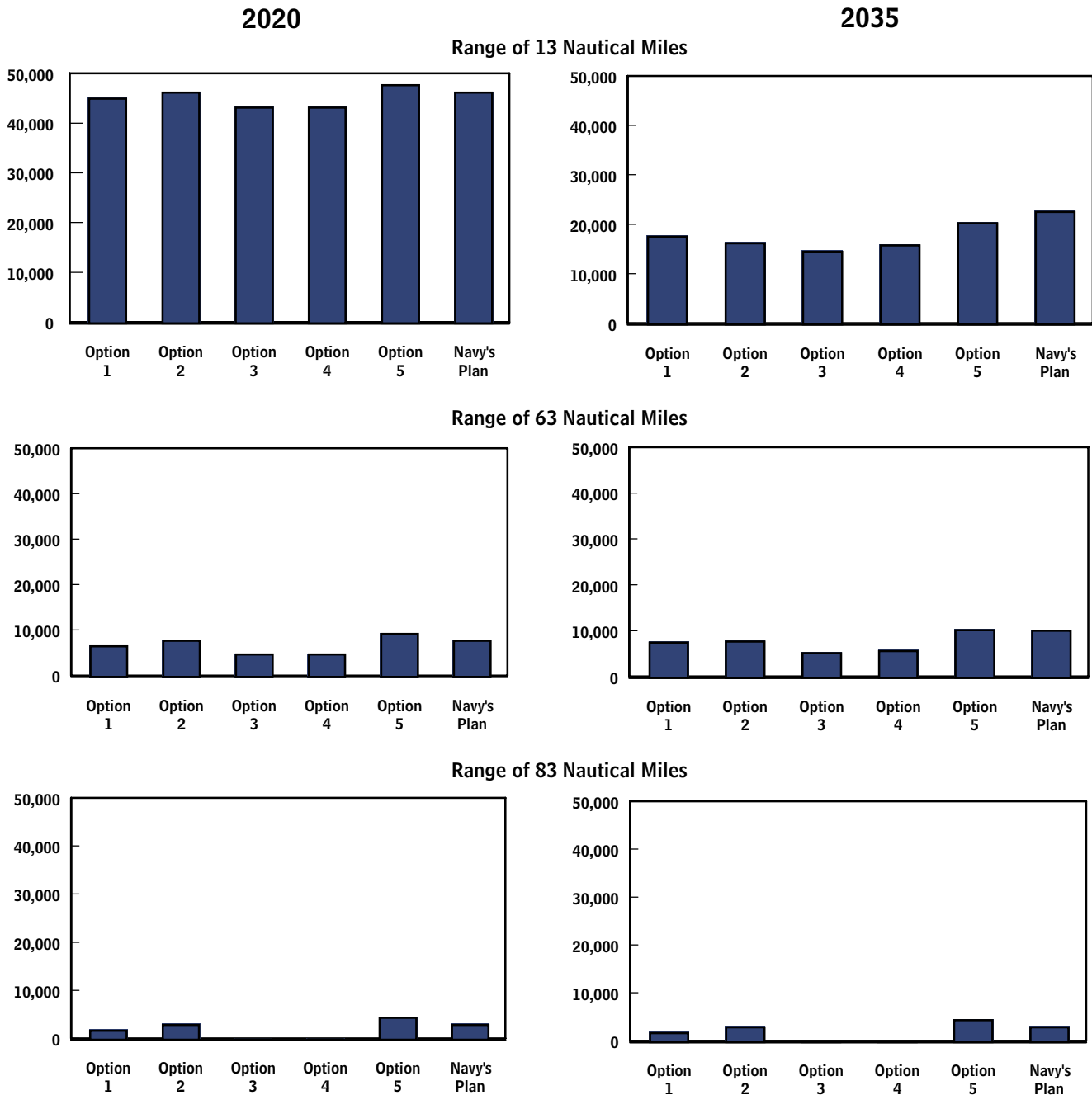


Source: Congressional Budget Office.

Figure 4-12.

Amount of Magazine Capacity That Could Be Surged to a Theater of Operations in Wartime Under Alternative Force Structures

(Number of shells)

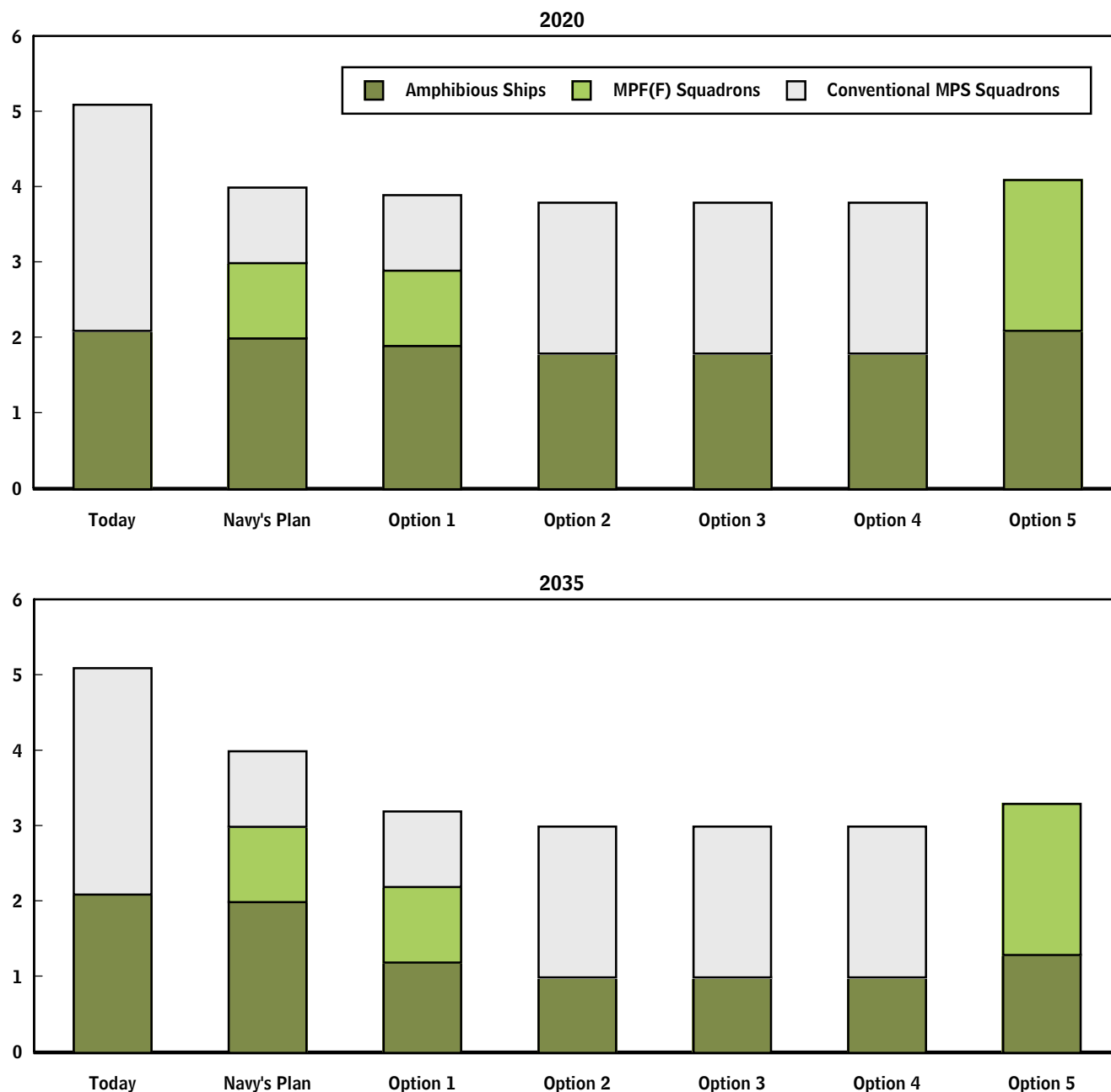


Source: Congressional Budget Office.

Figure 4-13.

Total Lift Provided by Amphibious and Maritime Prepositioning Forces in 2020 and 2035 Under Alternative Force Structures

(Number of Marine expeditionary brigades transported)



Source: Congressional Budget Office.

Note: MPF(F) = Maritime Prepositioning Force (Future); MPS = maritime prepositioning squadron.

Table 4-1.

Capabilities of the Navy's Battle Force Ships in 2020 and 2035 Under Alternative Force Structures

	Option 1 (Across-the- board cuts)	Option 2 (Surface combatants)	Option 3 (Submarines)	Option 4 (Aircraft carriers)	Option 5 (Sea basing)	Memorandum: Current Fleet ^a	Navy's 2006 Shipbuilding Plan
Capabilities in 2020							
Number of Battle Force Ships	299	300	296	278	323	285	326
Number of Strike Groups	34	35	32	34	35	36	35
Total Full-Load Displacement ^b (Millions of long tons)	4.8	4.2	4.1	4.2	5.0	4.4	5.2
Average Ship Age (Years)	19.4	19.0	19.2	20.2	18.0	16.4	18.0
Total Crew Size (Number of sailors)	100,000	102,000	102,000	103,000	106,000	109,000	114,000
Direct Operation and Support Costs for Ships ^c (Billions of 2007 dollars)	13.7	13.6	13.5	13.4	14.5	14.0	14.9
Number of Forward-Deployed Major Combatants	76	70	67	63	81	46	82
Number of Helicopter Hangars							
Forward deployed in peacetime	67	79	78	68	78	36	78
Surged in wartime	138	163	149	134	151	99	162
Number of VLS Cells							
Forward deployed in peacetime	3,200	3,200	3,000	3,100	3,100	2,100	3,300
Surged in wartime	6,900	7,000	6,600	6,800	6,700	5,600	7,100
Total Covert-Mission Days Provided by Attack Submarines	2,800	2,800	3,100	2,800	2,800	2,700	2,900
Number of Targets Attacked per Day by Carrier Aircraft in Wartime	3,900	3,900	3,900	4,000	3,900	3,500	4,000
Number of Guns Providing Naval Fire Support in Wartime (At 13/63/83 nautical miles)	78/29/6	81/31/10	72/23/0	72/23/0	82/33/10	63/0/0	82/33/10
Total Lift Capacity (MEBs)	3.9	3.8	3.8	3.8	4.1	5.1 ^d	4.0

Continued

Table 4-1.**Continued**

	Option 1 (Across-the-board cuts)	Option 2 (Surface combatants)	Option 3 (Submarines)	Option 4 (Aircraft carriers)	Option 5 (Sea basing)	Memorandum:	
						Current Fleet ^a	Navy's 2006 Shipbuilding Plan
Capabilities in 2035							
Number of Battle Force Ships	217	246	219	189	255	285	294
Number of Strike Groups	19	21	18	17	18	36	24
Total Full-Load Displacement ^b (Millions of long tons)	3.6	3.0	3.0	3.1	3.9	4.4	5.0
Average Ship Age (Years)	18.0	17.6	17.4	18.0	17.9	16.4	16.3
Total Crew Size (Number of sailors)	65,000	66,000	68,000	73,000	72,000	109,000	99,000
Direct Operation and Support Costs for Ships ^c (Billions of 2007 dollars)	9.2	9.4	9.0	9.3	10.0	14.0	13.1
Number of Forward-Deployed Major Combatants	57	60	51	43	74	46	74
Number of Helicopter Hangars							
Forward deployed in peacetime	57	84	66	56	66	36	72
Surged in wartime	127	190	133	123	139	99	172
Number of VLS Cells							
Forward deployed in peacetime	1,900	2,000	1,800	1,700	1,700	2,100	2,400
Surged in wartime	4,100	4,600	3,800	3,700	3,500	5,600	5,400
Total Covert-Mission Days Provided by Attack Submarines	1,900	1,700	3,100	1,700	1,700	2,700	2,400
Number of Targets Attacked per Day by Carrier Aircraft in Wartime	2,300	2,300	2,900	4,200	2,300	3,500	4,200
Number of Guns Providing Naval Fire Support in Wartime (At 13/63/83 nautical miles)	33/33/6	35/35/10	29/29/0	29/29/0	43/43/10	63/0/0	41/41/10
Total Lift Capacity (MEBs)	3.2	3.0	3.0	3.0	3.3	5.1 ^d	4.0

Source: Congressional Budget Office.

Note: VLS = vertical launch system; MEB = Marine expeditionary brigade.

- At the beginning of 2006.
- The weight of a ship when it is fully equipped and loaded with weaponry, crew, and supplies.
- Direct operation and support costs are those directly related to the number of ships in the fleet (such as costs for fuel, supplies, and compensation of personnel).
- Includes all three conventional maritime prepositioning squadrons, even if they are deployed to Iraq.

They would retain only 1.0 MEB's worth of lift on amphibious ships—not all of which would be available at one time—and would buy enough conventional maritime prepositioning ships for another 2.0 MEBs.

Implications of the Analysis

The central implication of CBO's analysis is that unless shipbuilding budgets increase or the Navy designs and builds much cheaper ships, the size of the fleet will fall substantially. The fleet's capability will not necessarily decline as well according to every measure, however. By such measures as long-range gunfire, number of helicopter hangars, carrier targets per day, and covert-mission days provided by submarines, one or more of the options that CBO examined would provide more capability than today's fleet (see Table 4-1 on page 76). Of course, the Navy's more expensive plan would provide greater amounts of most types of capability than would most of the options. Nevertheless, the number of strike groups and the amount of amphibious and maritime prepositioning lift would fall substantially from today's levels

under each option as well as under the Navy's shipbuilding plan.

Moreover, the trade-offs that would have to be made to keep Navy spending at recent funding levels are considerable. If history is a guide, Option 1, with its across-the-board cuts to the four major areas of naval warfare, would appear to be the path that the Navy is on. The result of that option is a balanced fleet but with only 211 ships. Option 4, which would maintain an 11-carrier force, would result in the smallest fleet, 181 battle force ships. The substantial power-projection capabilities provided by aircraft carriers and their air wings require sizable cuts in every other category of ship. Option 3, which would invest heavily in submarines, would also require large trade-offs with other major warfare categories, but not to the same degree as Option 4. The largest force structures would result from Options 2 and 5, which would maintain fleets of about 230 to 240 ships by purchasing large numbers of relatively inexpensive platforms: littoral combat ships in Option 2 and MPF(F) ships in Option 5.

Effect of the Options on the Amount of Shipbuilding Work

As explained in Chapter 3, the total weight of the Navy ships purchased each year, on average, offers an indication of the workload for shipyards that build naval vessels. Such weight is typically measured by a surface ship's lightship displacement (known as Condition A displacement for submarines), which is the weight of the vessel itself without crew members, materiel, weapons, or fuel on board.

Since 2000, the Navy has ordered ships at an average rate of almost 90,000 tons of lightship and Condition A displacement per year. The Navy's 2006 shipbuilding plan would raise that average to 97,000 tons a year (see Figure A-1). The five lower-cost alternatives in this study would yield orders averaging 45,000 to 77,000 tons annually for at least 30 years—a substantial reduction from recent levels.

To illustrate the potential impact of those options on shipbuilding, the Congressional Budget Office (CBO) computed two indexes. One indicates how the amount of lightship or Condition A displacement allocated to shipyards under the different options compares with the amounts allocated over the past six years. The second index does the same thing with budget authority for specific ship purchases.

The Split Between Shipyard Work and Government-Furnished Equipment

Whenever the Navy orders a warship, a percentage of the ship's funding is used by the government to purchase components that the shipbuilder will integrate into the vessel. Those components are referred to as government-furnished equipment. Nearly all of the remaining money is for the labor and materials that a shipyard uses to construct the vessel.¹ For example, if lawmakers appropriate

\$1.2 billion to buy an Arleigh Burke (DDG-51) class destroyer, the shipyard building the vessel receives about half that amount. The rest goes to purchase government-furnished equipment for the ship.

The percentage of funding that a shipyard receives directly varies considerably by type of ship (see Table A-1). For logistics ships such as T-AKEs, shipyards receive more than 90 percent of the budget authority appropriated for construction, reflecting the lack of major combat systems, weapons, or complex propulsion systems on those vessels. The shipyard's percentage is also high for aircraft carriers because the sheer size of a Nimitz class carrier accounts for most of the cost of the ship, even though the government is providing the combat systems and the nuclear propulsion, among other things. The funding breakdown also varies within a particular class of ships, but that variation is relatively small for the purposes of this analysis.

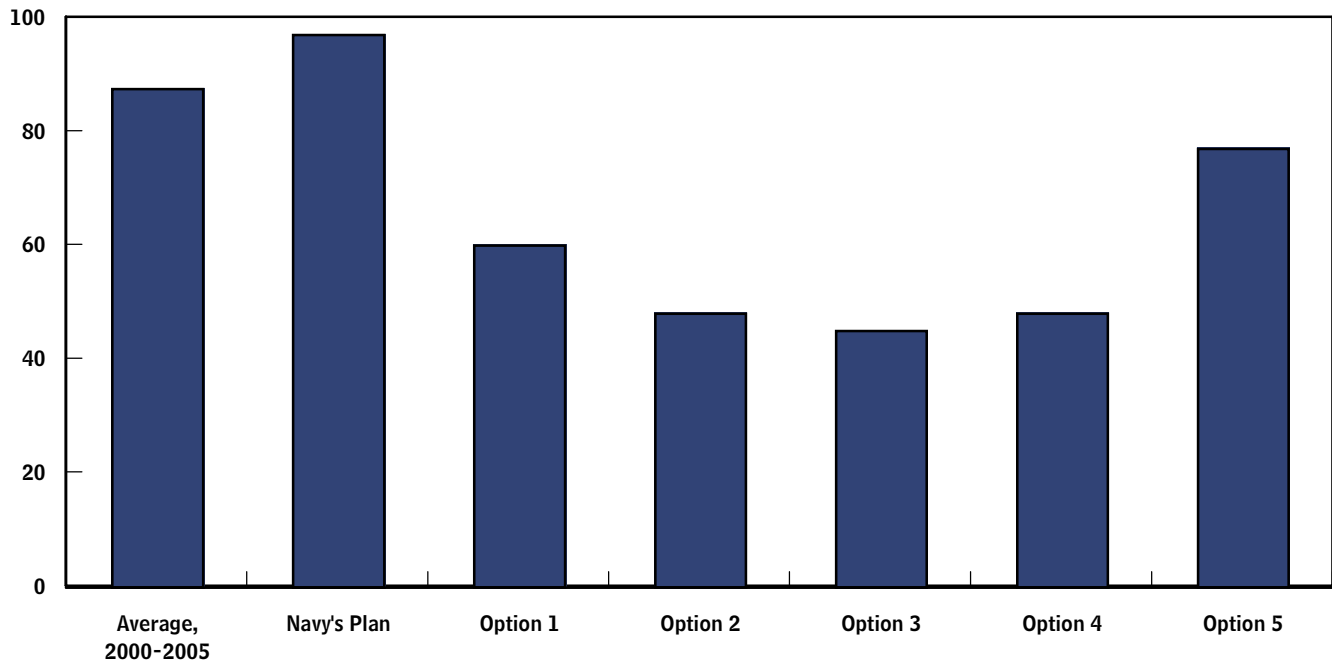
The funding that shipyards receive from the federal government to build new vessels does not represent their entire business. Other tasks, such as designing, repairing,

-
1. Six major U.S. shipyards build nearly all of the Navy's current ships. Those shipyards are Newport News, Avondale, and Ingalls, owned by Northrop Grumman; and Electric Boat, Bath Iron Works, and National Steel and Shipbuilding Company, owned by General Dynamics. For the past 10 years, Newport News' business has consisted mostly of constructing and refueling nuclear-powered aircraft carriers and sharing in the construction of attack submarines (along with Electric Boat). Avondale has built medium-sized amphibious ships and some kinds of support ships, and Ingalls has mainly constructed large surface combatants and large-deck amphibious assault ships. Bath Iron Works has mostly built destroyers, and National Steel and Shipbuilding Company has typically built a variety of combat logistics and support ships. On the basis of the contracts that the Navy has awarded, it appears that (at least initially) the new littoral combat ship will be built not by any of those shipyards but by smaller commercial yards working with Lockheed Martin or General Dynamics.

Figure A-1.

Average Annual Amount of Lightship and Condition A Displacement Allocated to Major Shipyards Under Alternative Force Structures, 2005 to 2035

(Thousands of long tons)



Source: Congressional Budget Office.

or converting ships, contribute to a shipyard's revenues. Some of the major shipyards also construct or repair commercial vessels; however, such business is small and increasingly rare.

Estimating Changes in Workload by Type of Ship

Using data provided by the Navy, CBO calculated the average annual construction of major types of ships that occurred between 2000 and 2005 in terms of displacement and funding. The funding numbers do not represent revenues or outlays but the amount of budget authority that will eventually be used to make payments to individual shipbuilders as they complete work according to the terms of their contracts. Those numbers exclude funding for government-furnished equipment.

Between 2000 and 2005, construction and refueling of aircraft carriers accounted for an average of about 13,000 tons of displacement and almost \$1.4 billion of budget authority allocated to shipyards (see Figure A-2). Shipyards received an average of about \$1.8 billion per year to

build 21,000 tons of large surface combatants and about \$2.2 billion per year to construct attack submarines at an average rate of 5,400 tons annually. (Ballistic missile submarines are not included in Figure A-2 because the Navy has not built any since 1989.) The shipyards building large and medium-sized amphibious ships, combat logistics ships, and support ships received between \$300 million and \$800 million per year, on average, to construct 5,000 tons to 34,000 tons of those vessels.

In addition to those recent averages, CBO computed five-year averages for displacement and budget authority during the 2006-2035 period under the Navy's plan and the five options considered here. For comparability, CBO converted those past and projected figures into a set of indexes; in each index, 1.0 was set to equal the 2000-2005 average for displacement or budget authority for a given category of ships, and the numbers for future five-year periods were divided by the past averages. Thus, for a given type of ship in a particular period, an index value higher than 1.0 suggests that the category of shipbuilding would be allocated at least as much tonnage or funding for new construction as in the past six years. Conversely,

Table A-1.**How Budget Authority for Ship Construction Is Allocated, by Ship**

(Percent)

	Government-Furnished Equipment ^a	Shipyard's Labor and Materials	Other	Total
CVN-77 Aircraft Carrier	20	79	1	100
Carrier Refuelings	13	85	2	100
SSN-774 Attack Submarine	33	66	1	100
DDG-51 Destroyer	48	50	2	100
LHD-8 Amphibious Assault Ship	18	78	4	100
LPD-17 Amphibious Transport Dock	25	74	1	100
T-AKE Dry Cargo/Ammunition Ship	8	92	0	100

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

a. Components (such as weapons or propulsion systems) that the government purchases and gives to the shipbuilder to integrate into a vessel.

an index value lower than 1.0 suggests that the ship category would be allocated less tonnage or funding over that period than in recent years.

Aircraft Carriers

Under the Navy's shipbuilding plan and the option that would maintain 11 carriers (Option 4), the index for carrier construction would be greater than 1 throughout the 30-year period of this study with respect to both lightship displacement and budget authority (see Figures A-3 and A-4). Under the remaining options—which would reduce the carrier force to seven or eight by delaying the CVN-21 program by 15 to 20 years—the displacement index would be less than 1.0 from 2006 to 2020. The budget authority index would be higher than 1.0, partly because there is substantial funding (more than \$3 billion per ship) associated with the overhaul and refueling of existing Nimitz class nuclear-powered carriers. However, those activities do not represent new construction and thus are not reflected in the lightship displacement index.

Large Surface Combatants

Throughout the projection period, the displacement and budget authority indexes for large surface combatants would be near or above 1.0 under the Navy's plan and the surface combatant alternative (Option 2). The only exception would occur during the 2026-2030 period under Option 2, when new cruiser construction had ended but new destroyer construction was limited to one ship per year. Option 1, with its across-the-board cuts, would maintain a steadier rate of construction than Option 2 according to both indexes, but at a lower level overall.

The other alternatives would construct large surface combatants at about half the recent levels between 2016 and 2030.²

Submarines

According to both the budget authority and displacement indexes, submarine construction would not fall below the historical average at any time through 2035 under any of the options in this analysis. All of the alternatives would build at least one attack submarine per year, on average, which is slightly more than in the 2000-2005 period. In addition, all of the options would buy a new class of ballistic missile submarine during most of the 30-year period.

The highest levels of submarine construction would occur under the Navy's plan and Option 3, because they would maintain the largest fleets of attack and ballistic missile submarines. The Navy's plan would keep 48 attack submarines and 14 ballistic missile submarines, whereas Option 3 would maintain 55 attack submarines, four guided missile submarines, and 10 ballistic missile submarines.

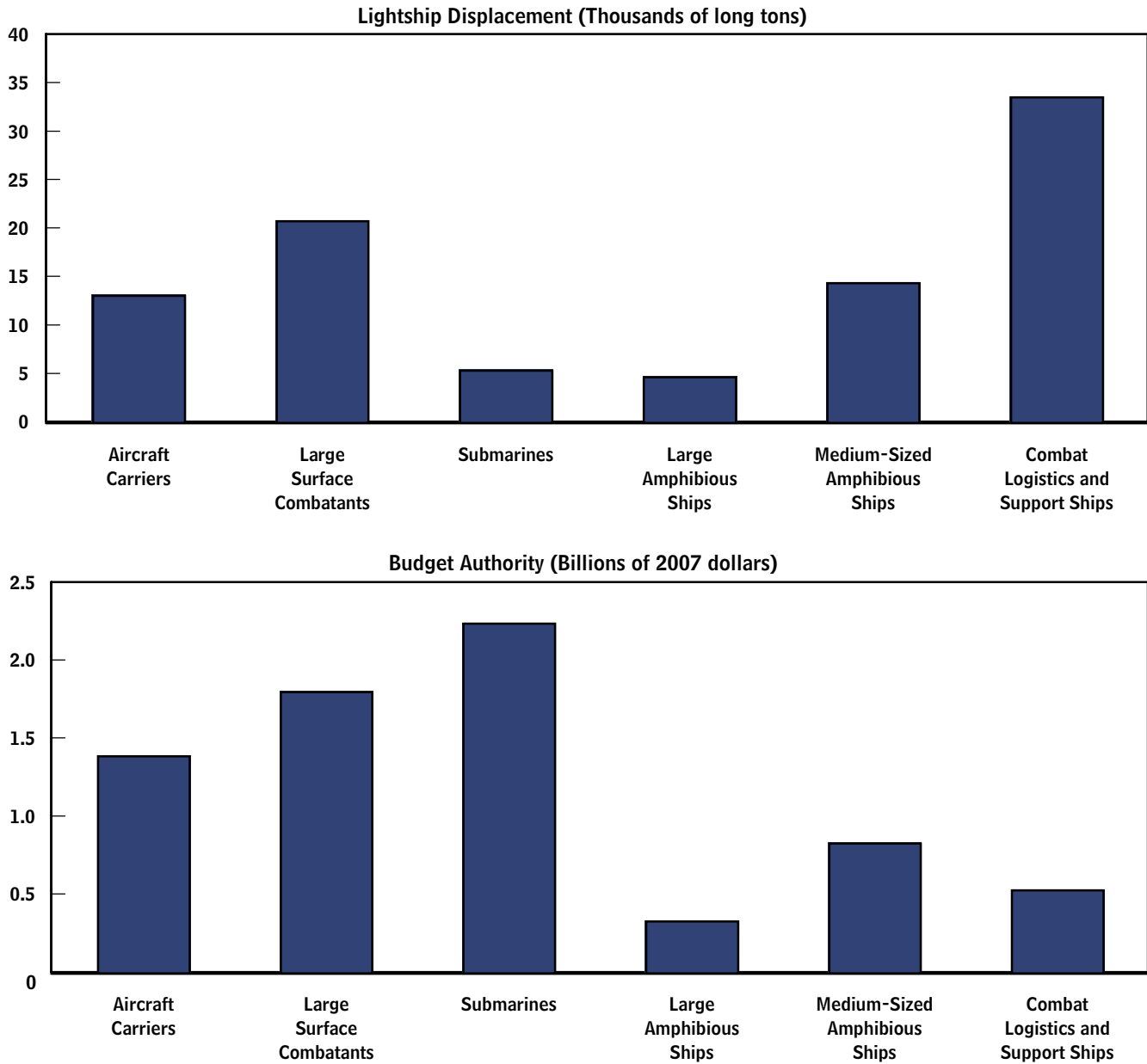
Large Amphibious Ships

By both of the indexes, only the sea-basing alternative (Option 5) would maintain a steady rate of construction of LHA or LHD class amphibious assault ships through 2035. That is a function of the option's goal of maintain-

2. CBO counted the LPD-17 fire-support ships in Option 5 as large surface combatants for the purposes of this analysis.

Figure A-2.

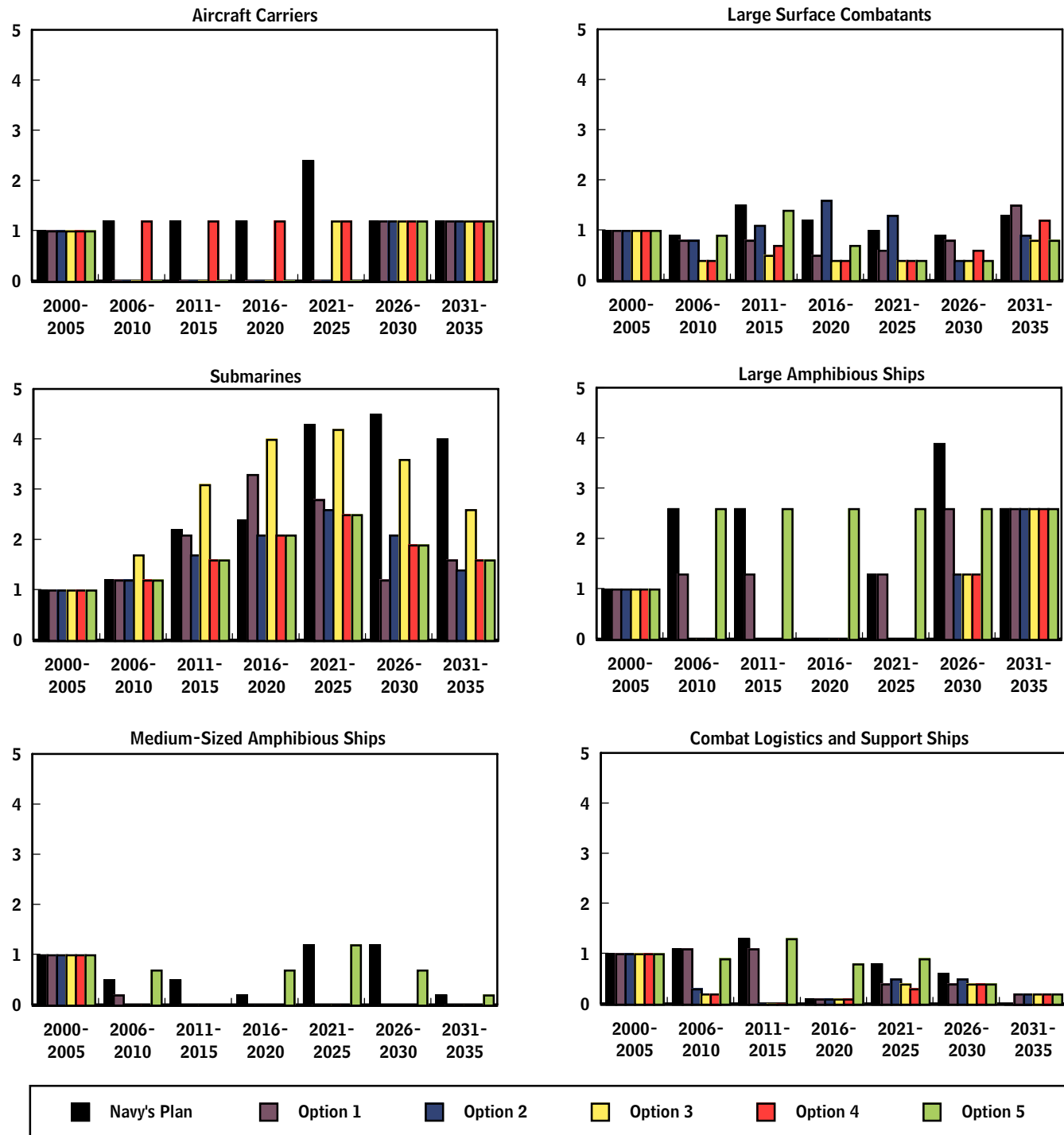
Average Annual Amount of Lightship Displacement and Budget Authority, by Major Category, 2000 to 2005



Source: Congressional Budget Office based on data provided by the Navy.

Figure A-3.

Lightship Displacement Allocation Index, by Major Ship Category, Under Alternative Force Structures

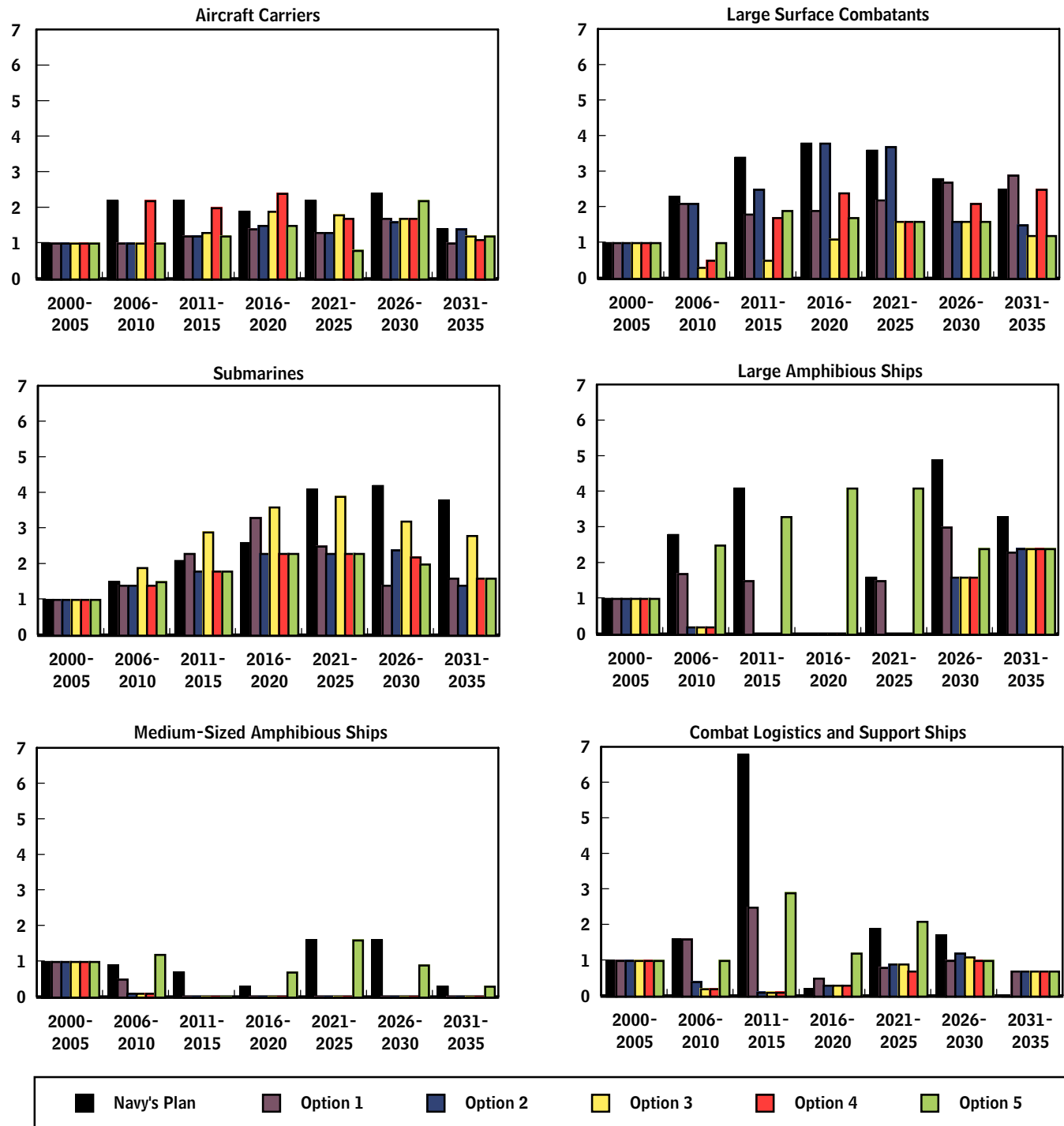


Source: Congressional Budget Office.

Note: For each category of ships, the average annual amount over the 2000-2005 period (shown in Figure A-2) becomes 1.0 in the index. For the projection period, numbers greater than 1.0 indicate conditions better than in the 2000-2005 period, and numbers less than 1.0 indicate conditions worse than in that period.

Figure A-4.

Budget Authority Allocation Index, by Major Ship Category, Under Alternative Force Structures



Source: Congressional Budget Office.

Note: For each category of ships, the average annual amount over the 2000-2005 period (shown in Figure A-2) becomes 1.0 in the index. For the projection period, numbers greater than 1.0 indicate conditions better than in the 2000-2005 period, and numbers less than 1.0 indicate conditions worse than in that period.

ing nine expeditionary strike groups as well as buying two MPF(F) squadrons, each of which would have three large amphibious ships.

The Navy's 2006 shipbuilding plan would provide a higher level of construction than in recent years, except during the 2016-2020 period, when no large amphibious ships would be built. Option 1, the across-the-board cuts, would also exceed recent construction levels through 2035 (except from 2016 to 2020) because it would maintain seven expeditionary strike groups and buy one MPF(F) squadron. The surface combatant, submarine, and carrier options, by contrast, would construct few or no large amphibious ships until the 2026-2030 period.

Medium-Sized Amphibious Ships

For most of the 2006-2035 period, both the budget allocation and displacement indexes would fall below the 2000-2005 level for medium-sized amphibious ships, such as LPDs and LSDs, under most of the options. Even the Navy's plan would significantly reduce funding for ships during the 2011-2020 and 2031-2035 periods.³ All of the options except the sea-basing alternative would build virtually no medium-sized amphibious ships for the

next 30 years. Under those options, the LPD-17 program would be terminated and no LSD replacements or MPF(F) ships would be purchased.

Combat Logistics and Support Ships

In the near term, the budget authority and displacement allocated to combat logistics and support ships would be less than half the recent average under Options 2, 3, and 4. By contrast, the Navy's plan and Options 1 and 5 would keep construction of those ships at or above the recent level through 2015.

By 2016, both indexes would fall below the 2000-2005 level under most of the alternatives. However, they would rebound in the 2020s as new oilers and fast combat support ships were purchased to replace ships that were retired from service. Overall, the sea-basing alternative (Option 5) would maintain the highest level of construction because of the large number of support ships associated with its two MPF(F) squadrons.

-
3. CBO included the two new command ships envisioned in the Navy's plan in this category because it assumed that those ships would be based on an LPD-17 hull.

