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Coast Guard Polar Security Cutter (Polar Icebreaker) Program: Background and Issues for Congress

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Summary

Required number of polar icebreakers. A 2023 Coast Guard fleet mix analysis concluded that the service will require a total of eight to nine polar icebreakers, including four to five heavy polar icebreakers and four to five medium polar icebreakers, to perform its polar (i.e., Arctic and Antarctic) missions in coming years.

Current operational polar icebreaker fleet. The operational U.S. polar icebreaking fleet currently consists of one heavy polar icebreaker, *Polar Star*, and one medium polar icebreaker, *Healy*. A second Coast Guard heavy polar icebreaker, *Polar Sea*. *Polar Sea*, suffered an engine casualty in June 2010 and has been nonoperational since then. *Polar Star* and *Polar Sea* entered service in 1976 and 1978, respectively, and are now well beyond their originally intended 30-year service lives. The Coast Guard plans to extend *Polar Star's* service life until the delivery of at least the second Polar Security Cutter (PSC; see next paragraph).

Polar Security Cutter (PSC). The Coast Guard PSC program aims to acquire four or five new PSCs (i.e., heavy polar icebreakers), to be followed at some later point by the acquisition of new Arctic Security Cutters (ASCs) (i.e., medium polar icebreakers). The Coast Guard in 2021 estimated PSC procurement costs in then-year dollars as $1,297 million (i.e., about $1.3 billion) for the first ship, $921 million for the second ship, and $1,017 million (i.e., about $1.0 billion) for the third ship, for a combined estimated cost of $3,235 million (i.e., about $3.2 billion). The procurement of the first two PSCs is fully funded. The Coast Guard's proposed FY2024 budget requested $170.0 million in continued procurement funding for the PSC program. The Coast Guard's proposed FY2025 budget requests no procurement funding for the PSC program. The Coast Guard originally aimed to have the first PSC delivered in 2024, but the ship's estimated delivery date has been delayed repeatedly and may now occur no earlier than 2028. Another potential issue concerns the accuracy of the PSC's estimated procurement cost, given the PSC's size and internal complexity as well as cost growth in other Navy and Coast Guard shipbuilding programs. The PSC's estimated procurement cost per weight is roughly half that of the Navy's LPD-17 Flight II and LHA amphibious ships. These amphibious ships are equipped with expensive combat system equipment that is not included in the PSC design, but whether this would account for all of the difference in cost per weight between the PSC design and the two amphibious ship designs is not clear. If substantial cost growth occurs in the PSC program, it could raise a question regarding whether to grant some form of contract relief to the PSC shipbuilder.

Commercially available polar icebreaker (CAPI). The Coast Guard's proposed FY2024 budget requested $125.0 million in procurement funding for the purchase of an existing commercially available polar icebreaker (CAPI) that would be modified to become a Coast Guard polar icebreaker. The Coast Guard's proposed FY2025 budget requests no procurement funding for CAPI, but the Coast Guard's FY2025 Unfunded Priorities List (UPL) includes an item for $25.0 million in procurement funding for the ship.

Great Lakes icebreaker (GLIB). The Coast Guard's proposed FY2024 budget proposed to initiate a new procurement program for procuring a new Great Lakes icebreaker (GLIB) that would have capabilities similar to those of *Mackinaw*, the Coast Guard's existing heavy Great Lakes icebreaker. The Coast Guard's proposed FY2024 budget requested $55.0 million in initial procurement funding for the ship, and the Coast Guard's FY2024 UPL included an item for an additional $20.0 million in procurement funding for the ship. The Coast Guard's proposed FY2025 budget requests no procurement funding for GLIB, but the Coast Guard's FY2025 UPL includes an item for $25.0 million in procurement funding for the ship.

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Introduction

This report provides background information and issues for Congress three Coast Guard icebreaker acquisition programs:

- the **Polar Security Cutter (PSC) program**—a program for acquiring four to five new heavy polar icebreakers to be known as PSCs;
- the **commercially available polar icebreaker (CAPI) program**—a program to purchase an existing commercially available polar icebreaker that would be modified to become a Coast Guard polar icebreaker; and
- the **Great Lakes icebreaker (GLIB) program**—a program to procure a new heavy Great Lakes icebreaker to augment the Coast Guard's current Great Lakes icebreaker fleet.

The Coast Guard's proposed FY2024 budget requested $170.0 million in continued procurement funding for the PSC program. The Coast Guard's proposed FY2025 budget requests no procurement funding for the PSC program.

The Coast Guard's proposed FY2024 budget requested $125.0 million in procurement funding for CAPI. The Coast Guard's proposed FY2025 budget requests no procurement funding for CAPI, but the Coast Guard's FY2025 Unfunded Priorities List (UPL) includes an item for $25.0 million in procurement funding for the ship.

The Coast Guard's proposed FY2024 budget requested $55.0 million in initial procurement funding for GLIB, and the Coast Guard's FY2024 UPL included an item for an additional $20.0 million in procurement funding for the ship. The Coast Guard's proposed FY2025 budget requests no procurement funding for GLIB, but the Coast Guard's FY2025 UPL includes an item for $25.0 million in procurement funding for the ship.

The issue for Congress is whether to approve, reject, or modify the Administration's procurement funding requests and acquisition strategies for the PSC, CAPI, and GLIB programs.

On July 18, 2023, CRS provided testimony on the PSC program to the House Homeland Security Committee subcommittee on Transportation and Maritime Security.[1] Separate CRS reports cover acquisition of general-purpose cutters for the Coast Guard[2] and waterways commerce cutters for the Coast Guard.[3] Another CRS report provides an overview of various issues relating to the Arctic.[4]

[1] CRS Testimony TE10084, *Strategic Competition in the Arctic*, by Ronald O'Rourke.

[2] CRS Report R42567, *Coast Guard Cutter Procurement: Background and Issues for Congress*, by Ronald O'Rourke.

[3] CRS In Focus IF11672, *Coast Guard Waterways Commerce Cutter (WCC) Program: Background and Issues for Congress*, by Ronald O'Rourke.

[4] CRS Report R41153, *Changes in the Arctic: Background and Issues for Congress*, coordinated by Ronald O'Rourke.

Background

Missions of Coast Guard Polar Icebreakers

Statutory Duties and Missions

The permanent statute that sets forth the Coast Guard's primary duties—14 U.S.C. 102—states that among other things, the Coast Guard shall (emphasis added) "develop, establish, maintain, and operate, with due regard to the requirements of national defense, aids to maritime navigation, **icebreaking facilities**, and rescue facilities for the promotion of safety on, under, and over the high seas and waters subject to the jurisdiction of the United States," and "pursuant to international agreements, develop, establish, maintain, and operate **icebreaking facilities** on, under, and over waters other than the high seas and waters subject to the jurisdiction of the United States.... "[5]

In addition, Section 888(a) of the Homeland Security Act of 2002 (H.R. 5005/P.L. 107-296 of November 25, 2002)—the law that established the Department of Homeland Security (DHS) and transferred the Coast Guard from the Department of Transportation to DHS—sets forth 11 specific missions for the Coast Guard (often referred to as the Coast Guard's 11 statutory missions), including the mission of "ice operations."[6]

Multiple Missions (Not Just Icebreaking)

The Coast Guard's polar icebreakers do not simply break ice—they are multimission cutters[7] that conduct a variety of other operations that are conducted in lower-latitude waters by the Coast Guard's general-purpose cutters. U.S. polar ice operations conducted in large part by the Coast Guard's polar icebreakers support 9 of the Coast Guard's 11 statutory missions.[8] The roles of U.S. polar icebreakers can be summarized as follows:

- conducting and supporting scientific research in the Arctic and Antarctic;
- defending U.S. sovereignty in the Arctic by helping to maintain a U.S. presence in U.S. territorial waters in the region;
- defending other U.S. interests in polar regions, including economic interests in waters that are within the U.S. exclusive economic zone (EEZ) north of Alaska;
- monitoring sea traffic in the Arctic, including ships bound for the United States; and

[5] 14 U.S.C. 102(4) and 102(5), respectively. This statute was previously 14 U.S.C. 2; it was renumbered as 14 U.S.C. 102 by Section 103 of the Frank LoBiondo Coast Guard Authorization Act of 2018 (S. 140/P.L. 115-282 of December 4, 2018). (Title I of P.L. 115-282, consisting of Sections 101-124, specified a general reorganization of Title 14.)

[6] The 11 missions set forth in Section 888(a) are marine safety; search and rescue; aids to navigation; living marine resources (fisheries law enforcement); marine environmental protection; ice operations; ports, waterways and coastal security; drug interdiction; migrant interdiction; defense readiness; other law enforcement.

[7] Cutters are commissioned Coast Guard vessels greater than 65 feet in length.

[8] For a list of the 11 missions, see footnote 6. The two statutory missions not supported by polar ice operations are illegal drug interdiction and undocumented migrant interdiction. (Department of Homeland Security, *Polar Icebreaking Recapitalization Project Mission Need Statement, Version 1.0*, approved by DHS June 28, 2013, p. 10.)

- conducting other typical Coast Guard missions (such as search and rescue, law enforcement, and protection of marine resources) in Arctic waters, including U.S. territorial waters north of Alaska.[9]

Polar (Not Just Arctic) Operations

The Coast Guard's large icebreakers are called polar icebreakers rather than Arctic icebreakers because they perform missions in both the Arctic and Antarctic. Operations to support National Science Foundation (NSF) research activities in both polar regions account for a significant portion of U.S. polar icebreaker operations.

Supporting NSF research in the Antarctic focuses on performing an annual mission, called Operation Deep Freeze (ODF), to break through Antarctic sea ice so as to reach and resupply McMurdo Station, the large U.S. Antarctic research station located on the shore of McMurdo Sound, near the Ross Ice Shelf. The Coast Guard stated in 2018 that *Polar Star*, the Coast Guard's only currently operational heavy polar icebreaker, "spends the [northern hemisphere] winter [i.e., the southern hemisphere summer] breaking ice near Antarctica in order to refuel and resupply McMurdo Station. When the mission is complete, the *Polar Star* returns to dry dock [in Seattle] in order to complete critical maintenance and prepare it for the next ODF mission. Once out of dry dock, it's back to Antarctica, and the cycle repeats itself."[10] In terms of the maximum thickness of the ice to be broken, the annual McMurdo resupply mission generally poses the greatest icebreaking challenge for U.S. polar icebreakers, though Arctic ice can frequently pose its own significant icebreaking challenges for U.S. polar icebreakers. The Coast Guard's medium polar icebreaker, *Healy*, spends most of its operational time in the Arctic supporting NSF research activities and performing other operations.

Although polar ice is diminishing due to climate change, observers generally expect that this development will not eliminate the need for U.S. polar icebreakers, and in some respects might increase mission demands for them. Even with the diminishment of polar ice, there are still significant ice-covered areas in the polar regions, and diminishment of polar ice could lead in coming years to increased commercial ship, cruise ship, and naval surface ship operations, as well as increased exploration for oil and other resources, in the Arctic—activities that could require increased levels of support from polar icebreakers, particularly since waters described as "ice free" can actually still have some amount of ice.[11] A 2007 National Research Council report stated that changing ice conditions in Antarctic waters had made the McMurdo resupply mission more challenging since 2000.[12] The Coast Guard's Arctic strategic outlook document, released in April 2019, states

> In order to prosecute its missions in the Arctic, the Coast Guard must fully understand and operate freely in this vast and unforgiving environment. Effective capability requires sufficient heavy icebreaking vessels, reliable high-latitude communications, and

[9] This passage, beginning with "The roles of ... ," originated in an earlier iteration of this CRS report and was later transferred by the Government Accountability Office (GAO) with minor changes to Government Accountability Office, *Coast Guard[:]Efforts to Identify Arctic Requirements Are Ongoing, but More Communication about Agency Planning Efforts Would Be Beneficial*, GAO-10-870, September 2010, p. 53.

[10] NyxoLyno Cangemi, "Coast Guard Icebreaker Crew Completes Second Arctic Mission; U.S. Interests in Arctic Domain Depends [sic] on Fleet Recapitalization," *DVIDS (Defense Visual Information Distribution System)*, October 19, 2018.

[11] For more on changes in the Arctic due to diminishment of Arctic ice, see CRS Report R41153, *Changes in the Arctic: Background and Issues for Congress*, coordinated by Ronald O'Rourke.

[12] National Research Council, *Polar Icebreakers in a Changing World, An Assessment of U.S. Needs*, Washington, 2007, pp. 6-7, 14, 63.

> comprehensive Maritime Domain Awareness. In order to respond to crises in the Arctic, our Nation must also muster adequate personnel, aviation, and logistics resources in the region. The Coast Guard is the sole provider and operator of the U.S. polar capable fleet but currently does not have the capability or capacity to assure access in the high latitudes. Closing the gap requires persistent investment in capabilities and capacity for polar operations, including the Polar Security Cutter.[13]

Current Coast Guard Polar Icebreakers

The operational U.S. polar icebreaking fleet currently consists of two ships—one heavy polar icebreaker, *Polar Star*, and one medium polar icebreaker, *Healy*. In addition to *Polar Star*, the Coast Guard has a second heavy polar icebreaker, *Polar Sea*. *Polar Sea*, however, suffered an engine casualty in June 2010 and has been nonoperational since then.

*Polar Sta*r and *Polar Sea* entered service in 1976 and 1978, respectively, and are now well beyond their originally intended 30-year service lives. The Coast Guard in recent years has invested millions of dollars to overhaul, repair, and extend the service life of *Polar Star*, but as a result of its advancing age, the ship's material condition has nevertheless become increasingly fragile, if not precarious. During its annual deployments to McMurdo Station in Antarctica, shipboard equipment frequently breaks, and shipboard fires have occurred.[14] Replacements for many of the ship's components are no longer commercially available. To help keep *Polar Star* operational, the Coast Guard is using *Polar Sea* as a source of replacement parts.

In February 2023, the Coast Guard issued a Request for Information (RFI) from companies interested in conducting a service life extension project (SLEP) for *Healy* that would begin in December 2025.[15] Responses to the RFI were due by March 16, 2023.[16]

For additional background information on current U.S. polar icebreakers and polar research ships, see **Appendix A**.

Required Numbers of Coast Guard Polar Icebreakers

The Coast Guard testified in April, June, and November 2023 that a new Coast Guard fleet mix analysis concluded that the service will require a total of eight to nine polar icebreakers, including four to five heavy polar icebreakers and four to five medium polar icebreakers, to perform its polar (i.e., Arctic and Antarctic) missions in coming years.[17] Prior to this new fleet mix analysis,

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[13] United States Coast Guard, *Arctic Strategic Outlook*, April 2019, p. 6.

[14] See, for example, Richard Read, "Meet the Neglected 43-Year-Old Stepchild of the U.S. Military-Industrial Complex," *Los Angeles Times*, August 2, 2019; Melody Schreiber, "The Only Working US Heavy Icebreaker Catches Fire Returning from Antarctica," *Arctic Today*, March 2, 2019; Calvin Biesecker, "Fire Breaks Out On Coast Guard's Aging, and Only, Heavy Icebreaker," *Defense Daily*, March 1, 2019.

[15] The project is envisaged as being accomplished through five annual work periods, each beginning in December of a given year and ending in April of the following year, with the first period beginning in December 2025 and ending in April 2026, and the fifth period beginning in December 2029 and ending in April 2030.

[16] See "Healy Service Life Extension Project (SLEP)," accessed July 20, 2023, at https://sam.gov/opp/63af5d5f7b9e492dbdc6b106210f5716/view.

[17] Spoken testimony, as reflected in CQ hearing transcripts, of

- Admiral Linda L. Fagan, Commandant of the Coast Guard, at an April 18, 2023, hearing on the Coast Guard's proposed FY2024 budget before the Coast Guard and Maritime Transportation subcommittee of the House Transportation and Infrastructure Committee, for the total figure of eight to nine polar icebreakers;
- Admiral Steven D. Poulin, Vice Commandant of the Coast Guard, at a June 21, 2023, hearing before the same subcommittee on the on the Coast Guard's emerging challenges and statutory needs, again for the total

(continued...)

the Coast Guard had stated that it would need at least six polar icebreakers, including three heavy polar icebreakers.

At a March 14, 204, hearing before the Senate Armed Services Committee, Air Force General Gregory M. Guillot, the Commander of the U.S. Northern Command (USNORTHCOM), when asked to comment about numbers of U.S. icebreakers for supporting U.S. operations in the Arctic in a context, stated that "we're severely outnumbered," and that "we do appreciate that the Coast Guard is—is procuring more icebreakers. But even with those, we will be severely outnumbered. And that does limit our freedom of maneuver in that region."[18]

For additional background information on required numbers of U.S. polar icebreakers, see **Appendix B**.

Coast Guard Polar Icebreaker Programs

New Polar Security Cutters (PSCs)

Overview

The PSC program was initiated in the Coast Guard's FY2013 budget submission, and envisages the acquisition of four to five new PSCs (i.e., heavy polar icebreakers), to be followed at some later point by the acquisition of new ASCs (i.e., medium polar icebreakers).

Program Name and Name of First Ship

The PSC program was previously known as the polar icebreaker (PIB) program. Changing the program's name to the PSC program is intended to call attention to the fact that the Coast Guard's polar icebreakers perform a variety of missions relating to national security, not just icebreaking.[19] Although it is now called the PSC program, observers as a matter of convenience might refer to it as the polar icebreaker program.

On February 24, 2022, the Coast Guard announced that the first PSC will be named *Polar Sentinel*, and that the Coast Guard has candidate names in mind for the second and third PSCs.[20]

figure of eight to nine polar icebreakers; and

- Vice Admiral Peter Gautier, Coast Guard Deputy Commandant for Operations, at a November 29, 2023, hearing before the House Homeland Security Committee on how U.S. Arctic strategy impacts homeland security, for both the total figure of eight to nine polar icebreakers and how that total includes four to five heavy polar icebreakers and four to five medium polar icebreakers.

[18] CQ transcript of hearing. See also Ella Sherman, "The US Military Doesn't Have the Icebreakers to Compete in the Arctic and Is 'Severely Outnumbered' by Russia, Commander Warns," *Business Insider*, March 14, 2024.

[19] See, for example, Ben Werner and Sam LaGrone, "Coast Guard Renames New Icebreaker Program 'Polar Security Cutter,'" *USNI News*, September 27, 2018. See also Sydney J. Freedberg Jr., "With Funding In Peril, Coast Guard Pushes Icebreaker As 'Polar Security Cutter,'" *Breaking Defense*, October 29, 2018.

[20] See, for example, Richard R. Burgess, "Commandant Names Future Polar Security Cutter 'Polar Sentinel,'" *Seapower*, February 24, 2022.

Home Port

On June 17, 2019, the Coast Guard announced that it intends to homeport its PSCs at Seattle, WA, where the Coast Guard's current polar icebreakers are homeported.[21]

Coast Guard-Navy Integrated Program Office (IPO)

The PSC program is managed by a Coast Guard-Navy Integrated Program Office (IPO). A key aim in establishing the IPO was to permit the Navy to share its ship-procurement best practices with the Coast Guard so as to help the Coast Guard reduce the time and cost needed to design and procure the PSCs.

Lead Ship Delivery Date

The Coast Guard originally aimed to have the first PSC delivered in 2024, but the ship's estimated delivery date has been delayed repeatedly, and as discussed in more detail later in this report, may now occur no earlier than 2028.

Estimated Procurement Cost

As shown in **Table 1**, the Coast Guard in 2021 estimated PSC procurement costs in then-year dollars as $1,297 million (i.e., about $1.3 billion) for the first ship, $921 million for the second ship, and $1,017 million (i.e., about $1.0 billion) for the third ship, for a combined estimated cost of $3,235 million (i.e., about $3.2 billion).[22] The shipbuilder's contract-award costs for the ships, which relate to the shipbuilder's portion of the total procurement cost of the ships, are discussed in the next section.

Table 1. Estimated PSC Procurement Costs as of 2021

(In millions of then-year dollars)

Cost element	1st PSC	2nd PSC	3rd PSC	Total
Ship construction	899	612	605	2,116
Nonrecurring cost	*155*	*0*	*0*	*155*
Recurring cost	*744*	*612*	*605*	*1,961*
Other program costs, including GFE	322	232	333	887
Post-delivery costs	48	49	50	147
Costs for Navy-Type, Navy-Owned (NTNO) equipment	28	28	29	85
TOTAL	**1,297**	**921**	**1,017**	**3,235**

Source: U.S. Coast Guard email to CRS, March 26, 2024, which states that costs shown are from the PSC 2021 LCCE v3 (Life Cycle Cost Estimate, version 3). The Coast Guard stated in the email that the 2021 LCCE v3 is the Coast Guard's current model for estimated PSC procurement costs.

[21] See, for example, Ben Werner, "Coast Guard Polar Security Cutter Will Be Homeported in Seattle," *USNI News*, June 17, 2019; Navy Times Staff, "Coast Guard Picks Homeport for New Icebreaker Fleet," *Navy Times*, June 17, 2019.

[22] A Government Accountability Office (GAO) report that was released on April 20, 2023, and that reports on the status of major DHS acquisition programs as of September 30, 2022, states that as of June 2022, the combined estimated procurement cost of the three PSCs was $2,789 million. (Government Accountability Office, *DHS Annual Assessment[:] Major Acquisition Programs Are Generally Meeting Goals, but Cybersecurity Policy Needs Clarification*, GAO-23-106701, April 2023, p. 50.)

Notes: The nonrecurring cost of $155 million for the 1st PSC includes $118 million for detail design costs for the class and $37 million for initial spares and repair parts for the 1st PSC. GFE is government-furnished equipment, meaning equipment that the government procures directly from supplier firms, and then provides to the shipbuilder for incorporation into the ship.

Competition and Contract Award

On April 23, 2019, the Coast Guard-Navy Integrated Program Office for the PSC program awarded a $745.9 million fixed-price, incentive-firm contract for the detail design and construction (DD&C) of the first PSC to Halter Marine Inc. of Pascagoula, MS, a shipyard that was owned by Singapore Technologies (ST) Engineering. Halter Marine was the leader of one of three industry teams that competed for the DD&C contract; the other two bidders reportedly were Bollinger Shipyards of Lockport, Louisiana, and a partnership between Philly Shipyard of Philadelphia and Fincantieri/Marinette Marine, of Marinette, WI.[23] The DD&C contract includes options for building the second and third PSCs. If both of these options are exercised, the total value of the contract would increase to $1,942.8 million (i.e., about $1.9 billion).[24]

The above figures of $745.9 million, $552.7 million, and $1,942.8 million cover only the shipbuilder's portion of the PSCs' total procurement cost; they do not include the cost of government-furnished equipment (or GFE, meaning equipment that the government purchases and then provides to the shipbuilder for incorporation into the ship), post-delivery costs, costs for Navy-specific equipment, or government program-management costs. On December 29, 2021, the Coast Guard exercised a $552.7 million fixed price incentive option to its contract with Halter Marine Inc. for the second PSC.[25]

In November 2022, ST Engineering sold Halter Marine to Louisiana-based Bollinger Shipyards. The former Halter Marine is now called Bollinger Mississippi Shipbuilding.[26] The shipyard's former name of Halter Marine occurs in the remainder of this report in connection with developments prior to November 2022.

Ship Design

Figure 1, **Figure 2**, **Figure 3**, **Figure 4**, and **Figure 5** show renderings and a photograph of Halter Marine's design for the PSC.

The PSC program is using the parent design approach, meaning that the design of the PSC is based on an existing icebreaker design. A key aim in using the parent design approach is to reduce cost, schedule, and technical risk in the PSC program.

[23] "Mississippi Shipyard Gets $746M Contract for Icebreaker," *Associated Press*, April 23, 2019.

[24] See Naval Sea Systems Command, "Polar Security Cutter Contract Awarded to Recapitalize Nation's Arctic Capabilities," April 23, 2019; Department of Defense, "Contracts for April 23, 2019" (Release No. CR-076-19); Sam LaGrone, "VT Halter Marine to Build New Coast Guard Icebreaker," *USNI News*, April 23, 2019; Maria Armental, "U.S. Orders First heavy Icebreaking Vessel in Decades, as Rivals Expand Arctic Presence," *Wall Street Journal*, April 23, 2019; "Mississippi Shipyard Gets $746M Contract for Icebreaker," Associated Press, April 23, 2019.

[25] U.S. Coast Guard, "Polar Security Cutter Integrated Program Office Exercises Option for Second Cutter," U.S. Coast Guard, December 30, 2021; Department of Defense, "Contracts for December 29, 2021."

[26] See, for example, Sam LaGrone, "Bollinger Closes $15M Acquisition of Halter Marine, New Name: 'Bollinger Mississippi Shipbuilding,'" *USNI News*, November 14, 2022; Cal Biesecker, "Bollinger Completes Acquisition Of Halter Marine," *Defense Daily*, November 14, 2022; Justin Katz, "Why a Small Shipyard Merger Could Signal Bigger Problems for the US Military," *Breaking Defense*, November 14, 2022; Sam LaGrone, "Updated: Bollinger to Buy Halter Marine Shipyard, Oversee Coast Guard Polar Security Cutter Program," *USNI News*, November 6, 2022.

Figure 1. Rendering of Halter Marine Design for PSC

Source: Illustration accompanying Sam LaGrone, "UPDATED: VT Halter Marine to Build New Coast Guard Icebreaker," USNI News, April 23, 2019, updated April 24, 2019. The caption to the illustration states "An artist's rendering of VT Halter Marine's winning bid for the U.S. Coast Guard Polar Security Cutter. VT Halter Marine image used with permission."

An April 25, 2019, press report states that "the Coast Guard and Navy said VT Halter Marine's winning design for the new Polar Security Cutter (PSC) 'meets or exceeds all threshold requirements' in the ship specification" for the PSC program.[27] A May 7, 2019, press release from Halter Marine about its design for the PSC (which Halter Marine updated on May 29 to provide a corrected figure for the design's full load displacement) stated the following:

> VT Halter Marine is teamed with Technology Associates, Inc. [TAI] as the ship designer and, for over two years, has participated in the U.S. Coast Guard's Heavy Polar Icebreaker Industry Study. The ship design is an evolution from the mature "Polar Stern II" [German icebreaker] currently in design and construction; the team has worked rigorously to demonstrate its maturity and reliability. During the study, TAI incrementally adjusted the design and conducted a series of five ship model tank tests to optimize the design. The vessels are 460 feet in length with a beam of 88 feet overall, a full load displacement of approximately 22,900 long tons at delivery. The propulsion will be diesel electric at over 45,200 horse power and readily capable of breaking ice between six to eight feet thick. The vessel will accommodate 186 personnel comfortably for an extended endurance of 90 days.
>
> In addition to TAI, VT Halter Marine has teamed with ABB/Trident Marine for its Azipod propulsion system,[28] Raytheon for command and control systems integration, Caterpillar for the main engines, Jamestown Metal Marine for joiner package, and Bronswerk for the

[27] Rich Abott, "Polar Icebreaker Winner Meets Threshold Requirements, Has Incentives For Early Delivery," *Defense Daily*, April 25, 2019.

[28] ABB is ASEA Brown Boveri, a multinational corporation headquartered in Zurich, Switzerland, that is, among other things, a leading maker of electric-drive propulsion systems for ships. (ASEA is an acronym for Allmänna Svenska Elektriska Aktiebolaget [i.e., General Swedish Electrical Limited Company], which merged with Brown, Boveri & Cie [BBC] in 1988 to create ABB.) Azipod is ABB's term for its azimuthing (i.e., swiveling) podded propulsors.

HVAC system. The program is scheduled to bring an additional 900 skilled craftsman and staff to the Mississippi-based shipyard.[29]

Figure 2. Model of Halter Marine Design for PSC

(Photograph of model displayed at 2021 trade show)

Source: Cropped version of photograph accompanying Peter Ong, "USGC's Polar Security Cutters To Receive Mark 38 Mod 4 Guns," *Naval News*, April 21, 2022. The article credits the photograph to Naval News at the Sea Air Space exposition 2021.

Figure 3. Rendering of Halter Marine Design for PSC

Source: Illustration posted by Robert A. Socha, Senior Vice President, Halter Marine, accessed May 6, 2019, at https://www.linkedin.com/feed/update/urn:li:activity:6526621529113976832.

[29] Halter Marine press release, "VT Halter Marine Awarded the USCG Polar Security Cutter," May 7, 2019, updated May 29, accessed June 12, 2019, at http://vthm.com/wp-content/uploads/2019/05/Press-Release_USCG-PSC_Singapore-Exchange-FINAL_updatedMay29.pdf. The original (May 7) version of the press release stated that the design's full load displacement at delivery would be approximately 33,000 tons.

Figure 4. Rendering of Halter Marine Design for PSC

Source: Technology Associates, Inc. (cropped version of rendering posted at http://www.navalarchitects.us/pictures.html, accessed June 10, 2020). A similar image was included in Halter Marine press release, "VT Halter Marine Awarded the USCG Polar Security Cutter," May 7, 2019, accessed May 8, 2019, at http://www.vthm.com/public/files/20190507.pdf.

Figure 5. Rendering of Halter Marine Design for PSC

Source: Photograph accompanying Connie Lee, "New Coast Guard Icebreaker Remains on Tight Schedule," *National Defense*, May 21, 2020. The article credits the photograph to Technology Associated, Inc.

The German icebreaker design referred to in Halter Marine's press release, *Polar Stern II* (also spelled *Polarstern II*) (**Figure 6**),[30] is to be built as the replacement for *Polarstern*, Germany's current polar research and supply icebreaker.[31]

Figure 6. Rendering of SDC Concept Design for *Polarstern II*

Source: Cropped version of SDC Ship Design & Consult GmbH, design SDC2187, 133m Research Vessel, accessed May 9, 2019, at http://www.shipdesign.de/html/index.php?navi=3&navi2=80&navi3=115. The image is enlarged at http://www.shipdesign.de/html/detail.php?id=396.

A May 9, 2019, press report states that *Polarstern II* was designed by Germany's Ship Design & Consult (SDC), a firm based in Hamburg, Germany.[32] SDC states that its concept design for *Polarstern II* has a length of 133 meters (about 436.4 feet) long, a beam of 27 meters (about 88.6 feet), and a draft of 10.5 meters (about 34.4 feet), but does not provide the design's

[30] *Polarstern* is the German word for Polar Star—coincidentally, the same name as the U.S. Coast Guard's operational heavy polar icebreaker.

[31] On February 14, 2020, the Alfred Wegener Institute (AWI), Helmholtz Centre for Polar and Marine Research, announced that "the [German] Federal Ministry of Education and Research (BMBF) today cancelled the Europe-wide call for tenders for the procurement of a new polar research vessel, Polarstern II, for legal reasons." (Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, "Call for Fender Procedure for the Construction of a Successor to the Icebreaker Polarstern Has Been Cancelled," February 14, 2020.) On June 3, 2022, however, AWI stated that "now that the federal budget for 2022 was approved by the German Bundestag on 3 June 2022, the construction procurement procedure for Polarstern II can begin. The AWI plans to promptly launch the Europe-wide procurement procedure so that the competitive bidding can start promptly as the first step. The handover of the completed ship is slated for 2027." (Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, "Polarstern II: German Bundestag Greenlights the Construction of New Icebreaker," June 3, 2022. See also Eurasia Review, "Polarstern II: German Bundestag Green-Lights Construction Of New Icebreaker," *Eurasia Review*, June 4, 2022; Michael Wenger, "Germany's 'Pola[r]stern II' Becomes Reality," *Polar Journal*, June 6, 2022.)

[32] Calvin Biesecker, "Long-Lead Funding In FY '20 For Second Polar Security Cutter Would Help With Planning, Shipbuilder Says," *Defense Daily*, May 9, 2019.

displacement.[33] A briefing on a preliminary version of the ship's design stated that the design at that point was somewhat larger, with a length of 145 meters (about 476 feet), a beam of 27.3 meters (about 89.6 feet), a draft of about 11 meters (about 36.1 feet), and a displacement (including payload) of about 26,000 tons.[34] These figures suggest that SDC's somewhat smaller concept design for *Polarstern II* might have a displacement (including payload) of something less than 26,000 tons, and perhaps closer to 23,000 tons. The May 9, 2019, press report states that

> VT Halter's teammates on the PSC include ship designer Technology Associates, Inc. (TAI), which has been involved in the design for over two years and has made "a lot of modifications" in a number of areas to meet Coast Guard requirements, [Ronald Baczkowski, president and CEO of VT Halter Marine] said. The team went through six design spirals to refine the design and the major modifications include changes in the hull form to enhance the ship's icebreaking capabilities and keep the ice clear from the propulsors and sensors, habitability improvements for comfort particularly in open water, easier access to different areas of the ship, and maintenance and endurance capabilities….
>
> Raytheon [RTN] is the integrator for C5I capabilities[35] on the ship and the main engines will be supplied by Caterpillar [CAT]. Switzerland-based ABB and Netherlands-based Trident are supplying the Azipod propulsion system, Florida-based Jamestown Metal Marine is supplying the joiner package, and Netherlands-based Bronswerk the heating, ventilation and cooling system.[36]

Halter Marine's 22,900-ton design for the PSC is considerably larger than the Coast Guard's current polar icebreakers. As shown in tons in **Table A-1**, the Coast Guard's largest polar icebreaker, *Healy*, is 420 feet long and has a full load displacement of 16,000 tons. Halter Marine's 460-foot design for the PSC is 40 feet longer than *Healy*, and its 22,900-ton displacement is about 43% greater than *Healy's*.

The horsepower generated by the propulsion plant in Halter Marine's design—more than 45,200, according to the earlier-quoted May 7, 2019 press release from Halter Marine—is roughly one-quarter less than the 60,000 shaft horsepower of the propulsion plant in the Coast Guard's heavy polar icebreaker, *Polar Star*. As shown in **Figure 1** and **Figure 3**, however, Halter Marine's design includes a centerline shafted propeller flanked by two azimuthing (i.e., swiveling) podded propulsors—an arrangement that, along with other modern icebreaker hull design features, is expected to give Halter Marine's design a capability for breaking ice comparable to that of *Polar Star*. A May 8, 2019, press report states the following:

> "We picked the most modern icebreaker that was on the market, soon to be production-level design that roughly met the Coast Guard's requirements, and we took it and modified it," Baczkowski said.
>
> "It has a contoured shape. The shape of the hull does the icebreaking. Instead of being a mass breaking ice, this actually slices the ice. The shape of the hull pushed the broken ice aside, so it doesn't interfere with your propulsion systems, with your instrumentation that's on the other side of the ship."

[33] SDC Ship Design & Consult GmbH, design SDC2187, 133m Research Vessel, accessed May 9, 2019, at http://www.shipdesign.de/html/index.php?navi=3&navi2=80&navi3=115.

[34] Briefing entitled "Shipboard Polar Research, 32 Years Polarstern and the requirement for Polarstern II," accessed May 8, 2019, at http://www.ervo-group.eu/np4/np4/%7B$clientServletPath%7D/?newsId=43&fileName=Pr_sentation_Markterkundung_09.09.14_fin.pdf. The briefing is undated but includes a statement on one of its slides that refers in the past tense to an event that took place in January 2016.

[35] C5I stands for command, control, communications, computers, collaboration, and intelligence.

[36] Calvin Biesecker, "Long-Lead Funding In FY '20 For Second Polar Security Cutter Would Help With Planning, Shipbuilder Says," *Defense Daily*, May 9, 2019. Abbreviations for firm names in brackets as in original.

> The design of the cutter is optimized for seakeeping to support the long voyage from its homeport in Washington State to as far away as the Antarctic, he said.
>
> "It's an optimum design between icebreaking and seakeeping."
>
> "With the propulsors, with one fixed and two steerable, we were able to optimize the seakeeping capability so when you're going on long transits from Washington to Antarctica the crew is not beat to a pulp or heavily fatigued because of the stability characteristics in open water."[37]

Procurement Funding Through FY2023

As shown in **Table 2**, the PSC program through FY2023 has received a total of about $1,881.8 million in procurement funding, including $300.0 million from the Navy's shipbuilding account. With this funding, the procurement of the first two PSCs is fully funded, and the Coast Guard is seeking procurement funding for the third PSC.

Table 2. Procurement Funding for PSC Program Through FY2023

(In millions of dollars)

	Appropriated			
Fiscal year	**Coast Guard funding**	**Navy funding**	**Total funding**	***Requested by Coast Guard for that year***
FY13	7.609		7.609	*8.0*
FY14	2.0		2.0	*2.0*
FY15	0.0		0.0	*6.0*
FY16	36.0		36.0	*4.0*
FY17	25.0	150.0	175.0	*147.6*
FY18	19.0	150.0	169.0	*19.0*
FY19	675.0		675.0	*750.0*
FY20	135.0		135.0	*35.0*
FY21	555.0		555.0	*555.0*
FY22	80.0		80.0	*170.0*
FY23	47.2		47.2	*167.2*
Total	**1,581.809**	**300.0**	**1,881.809**	*n/a*

Source: U.S. Coast Guard and Navy budget data. Figures reflect post-enactment adjustments due to reprogramming actions or recissions. The FY2016 figure of $36.0 million includes $30.0 million that was added after enactment through a reprogramming action, as noted in the Coast Guard's FY2018 budget submission.

Notes: Coast Guard procurement funding shown in the table was provided through the Coast Guard's Procurement, Construction, and Improvements (PC&I) account. (Prior to FY2019, the PC&I account was called the Acquisition, Construction, and Improvements (AC&I) account.) Navy procurement funding shown in the table was provided through the Shipbuilding and Conversion, Navy (SCN) account (i.e., the Navy's shipbuilding account). All procurement funding requested over the years for the PSC program has been requested by the Coast Guard for the Coast Guard's procurement account. The Navy procurement funding provided in FY2017 and FY2018 was not requested by the administration and was added by Congress in marking up the Navy's proposed FY2017 and FY2018 shipbuilding budgets.

[37] Sam LaGrone, "VT Halter Marine Details Coast Guard Icebreaker Bid," *USNI News*, May 8, 2019.

FY2024 Procurement Funding Request

The Coast Guard's proposed FY2024 budget requested $170.0 million in continued procurement funding for the PSC program, which would be used for procurement of long leadtime materials (LLTM) and government-furnished equipment (GFE) for the PSCs, and for other program expenses. (GFE is equipment for the ships that the government purchases and then provides to the shipbuilder for incorporation into the ships.)

FY2025 Procurement Funding Request

The Coast Guard's proposed FY2025 budget requests no procurement funding for the PSC program.

Existing Commercially Available Polar Icebreaker (CAPI)

The Coast Guard wants to purchase of an existing commercially available polar icebreaker (CAPI) that would modified to become a Coast Guard polar icebreaker, so as to help augment the Coast Guard's current polar icebreaking capacity until the new PSCs enter service, and to continue augmenting the Coast Guard's polar icebreaking capacity after the PSCs enter service. Under the Coast Guard's proposal, the Coast Guard would conduct a full and open competition for the purchase, the commercially available icebreaker that the Coast Guard selects for acquisition would be modified for Coast Guard operations following its acquisition, and the ship would enter service 18 to 24 months after being acquired. The total cost to purchase the ship and then modify it to meet Coast Guard mission needs is uncertain.

Prior to 2021, the Coast Guard plans did not include the acquisition of such a ship. The Coast Guard's FY2022 UPL, dated June 29, 2021, however, included a $150.0 million item for the lease or purchase of a commercially available vessel to provide polar icebreaking capability until the future delivery of PSCs.[38] The following year, the Coast Guard as part of its proposed FY2023 budget requested $125.0 million in procurement funding for the purchase of an existing commercially available polar icebreaker. Congress, in acting on the Coast Guard's proposed FY2023 budget, denied the request. The Coast Guard once again requested the $125.0 million as part of its proposed FY2024 budget. The Coast Guard's proposed FY2025 budget requests no procurement funding for CAPI, but the Coast Guard's FY2025 UPL includes an item for $25.0 million in procurement funding for the ship.

On May 3, 2022, the Coast Guard released a Request for Information (RFI) regarding commercially available polar icebreakers, with responses due by June 10, 2022. A May 4, 2022, press report about the RFI states that the Coast Guard is

> seeking to identify commercial vessels that are available for purchase in 2023 or 2024. To meet the request the vessels must not only have been built in a U.S. shipyard but must have PC3 or higher classification and the capability of breaking at least three feet of ice ahead at a continuous speed of three knots. Further, it must have at least 15 years of original design service life remaining and be capable of operations for a minimum of 60 days without resupply. Other specifications include a maximum draft of 29 feet and a landing area of Coast Guard helicopters.
>
> Respondents are asked to provide full details on the vessel but not specifically proprietary information at this stage which is only for the Coast Guard's planning purposes. However,

[38] U.S. Coast Guard, *FY 2022 Unfunded Priorities List, Report to Congress*, June 29, 2021, p. 3.

> they are requesting details including the fair market value of the vessel and the estimated price for the purchase of the vessel, technical data, and data rights.[39]

An April 28, 2022, press report states that the commercial ship that would be "the most likely" candidate to be purchased under the Coast Guard's proposal is *Aiviq*, a ship that is discussed further in **Appendix A** of this report. The press report states

> The most likely candidate is *Aiviq*, an ice-hardened tug supply vessel built by Edison Chouest in 2012 for $200 million. The other privately owned icebreaker in the U.S., *Nathaniel B. Palmer*, was built for the National Science Foundation, which leases the ship.
>
> The 360-foot *Aiviq* was intended for Shell's oil exploration in the Beaufort and Chukchi seas—primarily for towing and laying anchors, but also for responding to oil spills. But when Shell shelved its oil exploration plans in 2015, the *Aiviq* was left without a mission.
>
> The ship is currently being leased by Australia for work in Antarctica. Its ice classification would accommodate work in the Arctic for six months of the year and in Antarctica for four months of the year, but it would require significant modifications to adapt it to the Coast Guard's specifications.
>
> In 2016, Rep. Don Young, the late Republican representing Alaska, pressed Coast Guard leadership on a proposal to acquire the *Aiviq*.
>
> At the time, Adm. Charles Michel, then vice commandant of the service, responded that "our current opinion is that ship is not suitable for military service without substantial refit."[40]

At a May 12, 2022, hearing on the Coast Guard's proposed FY2023 budget, then-Commandant of the Coast Guard Admiral Karl Schultz testified that

> We can get a commercially available breaker fairly quick, bridge that [polar icebreaking] gap from a capacity standpoint. We had—the conversation [about how to bridge the gap] started as a lease conversation [i.e., a conversation about leasing an existing ship]. I—we—we shaped it [i.e., the conversation] to say, well, if we're going to lease something, we could actually do this much cheaper, onboard it [i.e., purchase the ship rather than lease it], turning it into a Coast Guard ship.
>
> So, 125 [million dollars] to procure the vessel, hopefully, that's what we're thinking, [and] 25 million [addition dollars] for—for crewing. There's probably a bill—125, 250 million [additional million dollars] to really outfit it over some outyear budget cycles [i.e., further modify and/or equip the ship over a period of some additional years]. That would be [i.e., doing that would produce] a medium icebreaker [that would be] in the Coast Guard inventory. There's one domestically available ship that's only 10 years old with very little use on it. We could—we could use that ship to shape our thinking about what the Arctic security requirements could look like.[41]

On March 1, 2024, the Coast Guard issued a notice of intent, which it updated on March 4, 2024, stating (as updated on March 4)

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[39] Maritime Executive, "US Coast Guard Seeks Information to Purchase Commercial Icebreaker," *Maritime Executive*, May 4, 2022. See also Cal Biesecker, "Coast Guard Seeks Information On Commercial Polar Icebreaker For Purchase," *Defense Daily*, May 4, 2022.

[40] Melody Schreiber, "US Coast Guard Proposes Purchase of Existing Icebreaker as Arctic 'Bridging Strategy,'" *Arctic Today*, April 28, 2022. See also Craig Hooper, "U.S. Coast Guard, Desperate For New Polar Icebreakers, Eyes A Used Ship," *Forbes*, May 11, 2022.

[41] Source; Congressional Quarterly (CQ) transcript of hearing. See also Cal Biesecker, "Commercial Icebreaker Would Inform Requirements For Arctic Security Cutter, Schultz Says," *Defense Daily*, May 12, 2022. See also William Mauldin and Doug Cameron, "U.S. Looks to Buy Private Icebreaker to Help Patrol Contested Arctic," *Wall Street Journal*, November 19, 2022.

> In accordance with Federal Acquisition Regulation (FAR) 5.204, the United States Coast Guard (USCG) intends to solicit for a Firm-Fixed-Price contract to Offshore Service Vessels, LLC to acquire and service a domestically produced, commercially available icebreaker with the objective to provide an operational surface asset capable of projecting U.S. presence in the Arctic. This solicitation will be issued as a sole-source request in accordance with FAR 6.302-1: Only One Responsible Source and No Other Supplies or Services Will Satisfy Agency Requirements.
>
> Offshore Service Vessels, LLC is the only company that can meet USCG needs based on the requirements set forth in the Request for information (RFI) Notice ID – 70Z02322ICICC2200….
>
> This synopsis is for notification purposes only and does not constitute a solicitation for bids or proposals. THIS IS NOT A REQUEST FOR COMPETITIVE OFFERS and a solicitation will not be issued. Any response to this notice must show clear and convincing evidence that competition of this requirement would be advantageous to the Government. Any vendor that believes it can meet the icebreaker requirements can provide documentation demonstrating their commercial vessel capabilities to the Contracting Officer. A determination by the Government not to compete this proposed requirement based upon responses to this notice is solely within discretion of the Government.[42]

Service Life Extension for *Polar Star*

The Coast Guard plans to extend the service life of *Polar Star* until the delivery of at least the second PSC.[43] The Coast Guard estimated the cost of *Polar Star's* service life extension work at $75 million, a sum that was funded at a rate of $15 million per year for five years, with the final $15 million increment being provided in FY2023. The funding was included in the vessels portion of the Coast Guard's PC&I account, in a line item called "Polar Sustainment" that is separate from the line item for the PSC program.

Coast Guard Great Lakes Icebreakers

Current Fleet

The Coast Guard's current Great Lakes icebreaker fleet consists of nine cutters:

- one heavy icebreaker—*Mackinaw* (WLBB-30), a 240-foot ship displacing 3,500 tons;

[42] "Synopsis: USCG Intent to Sole Source Commercially Available Polar Icebreaker (Updated)," SAM.gov, accessed March 14, 2024, at https://sam.gov/opp/a12ad39d150d4df0ab6e4773d1cf17d0/view. See also Cal Biesecker, "Coast Guard Moves Closer To Acquiring Commercial Polar Icebreaker," *Defense Daily*, March 4, 2024; Joseph Trevithick, "Coast Guard Poised To Buy Badly Needed Private Icebreaker," *The War Zone*, March 4, 2024.

[43] In February 2020, for example, the Coast Guard testified that

> The Coast Guard also understands that we must maintain our existing heavy and medium icebreaking capability while proceeding with recapitalization.... Maintenance of POLAR STAR will be critical to sustaining this capability until the new PSCs are delivered. Robust planning efforts for a service life extension project on POLAR STAR are already underway and initial work for this project will begin in 2020, with phased industrial work occurring annually from 2021 through 2023. The end goal of this process will be to extend the vessel's service life until delivery of at least the second new PSC.
>
> (Testimony of Admiral Charles W. Ray, Coast Guard Vice Commandant, on "Arctic Security Issues," before the House Homeland Security Subcommittee on Transportation & Maritime Security, February 5, 2020, p. 9.)

- six 140-foot *Bay*-class icebreaking tugs displacing 662 tons each; and
- two 225-foot *Juniper*-class seagoing buoy tenders displacing about 2,000 tons each that have a light icebreaking capability.[44]

Although *Mackinaw* is referred to as a heavy icebreaker, the word *heavy* in this instance is being used in the context of Great Lakes icebreaking—*Mackinaw* is much larger and has more icebreaking capability than the eight other ships listed above.[45] *Mackinaw* would not, however, qualify as a heavy polar icebreaker, as it is much smaller and has much less icebreaking capability than a heavy polar icebreaker.[46]

New Great Lakes Icebreaker (GLIB)

Since at least 2009, some Members of Congress have expressed interest in bolstering the Coast Guard's Great Lakes icebreaking fleet by procuring a second icebreaker with capabilities generally similar to those of *Mackinaw*.[47] Prior to October 2021, the Coast Guard generally stated that it did not view the procurement of additional Great Lakes icebreakers as an urgent near-term acquisition need, given the capabilities of the current Great Lakes icebreaking fleet, the relatively young age of *Mackinaw* (which entered service in 2006), service life extension work being done on the ice-breaking tugs that is designed to add 15 years to their service lives, and Canada's own Great Lakes icebreaking capabilities.[48] In October 2021, then-Commandant of the Coast Guard

[44] Source: U.S. Coast Guard, "Ninth Coast Guard District Units," accessed December 12, 2023, at https://www.atlanticarea.uscg.mil/Atlantic-Area/Units/District-9/Ninth-District-Units/. A total of 10 cutters are assigned to the Ninth District, which is responsible for the Great Lakes, the Saint Lawrence Seaway, and parts of the surrounding states. The 10th cutter assigned to the Ninth District is a 100-foot inland buoy tender whose primary missions do not include icebreaking.

[45] At continuous speeds of 3 knots, *Mackinaw* can break ice up to 32 inches thick, the 140-foot icebreaking tugs can break ice up to 22 inches thick, and the 225-foot seagoing buoy tenders can break ice up to 14 inches thick.

[46] As discussed earlier in this report, the Coast Guard's two heavy polar icebreakers—the operational *Polar Star* and the nonoperational *Polar Sea*—are 399 feet long and displace about 13,200 tons each. *Polar Star* can break ice up to six feet (72 inches) thick at a continuous speed of 3 knots. The Coast Guard states that *Mackinaw* is equivalent to the Canadian Coast Guard ship *Samuel Risley*, a Great Lakes-homeported icebreaker and buoy tender that Canada classifies as a light icebreaker in a comparison conducted across its entire icebreaking fleet, including its Arctic icebreakers. (U.S. Coast Guard, *Great Lakes Icebreaking Mission Analysis, Fiscal Year 2016 Report to Congress*, August 30, 2016, p. 5.)

[47] See, for example, H.R. 1747 of the 111th Congress, the Great Lakes Icebreaker Replacement Act, which was introduced on March 26, 2009, reported by the Committee on Transportation and Infrastructure on April 21, 2009 (H.Rept. 111-81), and agreed to by the House by voice vote on April 27, 2009. A similar bill, S. 1024, was introduced in the Senate on May 12, 2009.

[48] A 2016 Coast Guard report to Congress on the Great Lakes icebreaking mission, for example, stated the following:

> The current mix of heavy and medium [Great Lakes] icebreakers is capable of managing priorities and requests for icebreaking in Tier 1 and 2 waterways. When a severe ice season stresses Coast Guard asset capabilities, the existing agreement and partnership with Canada fills the capability gap and brings in extra heavy-icebreaking resources to manage the ice.... [T]he 2014 and 2015 ice seasons were a 20-year anomaly, consuming almost twice as many cutter resource hours as in any other year since 2005.
>
> The Coast Guard cannot reliably predict the economic impact of maintaining a single heavy Great Lakes icebreaker. Additionally, given the extreme conditions when ice coverage exceeds 90 percent, it is not clear that shipping delays would be significantly mitigated by an increase in icebreaking capability. Delays can be associated with several factors such as slow transit speeds, availability of pilots, and simultaneous and competing demand signals for icebreaking services across the Great Lakes.
>
> (U.S. Coast Guard, *Great Lakes Icebreaking Mission Analysis, Fiscal Year 2016 Report to Congress,* August 30, 2016, p. 11. The report was required by S.Rept. 114-68 of June 18, 2015, the

(continued...)

Admiral Karl Schultz expressed support for procuring an additional heavy Great Lakes icebreaker as part of a budget reconciliation bill.[49] For additional discussion, see **Appendix C**.

The Coast Guard's proposed FY2024 budget proposes to initiate a new procurement program for procuring a new Great Lakes icebreaker (GLIB) that would have capabilities similar to those of *Mackinaw*. The Coast Guard's proposed FY2024 budget requested $55.0 million in initial procurement funding for the ship, whose total acquisition cost, the Coast Guard estimates, might be roughly $350 million, depending in part on the exact design that is developed for the ship. (In January 2024, GAO reported that the Coast Guard's 2022 Mission Need Statement for domestic icebreaking estimated the procurement cost of a heavy domestic icebreaker at $216.3 million as of 2020.[50])

The Coast Guard's FY2024 UPL included an unfunded priority for an additional $20.0 million for the ship that would be used for accelerating initial procurement of LLTM for the ship. The Coast Guard's proposed FY2025 budget requests no procurement funding for GLIB, but the Coast Guard's FY2025 UPL includes an item for $25.0 million in procurement funding for the ship.

January 2024 GAO Report

A January 16, 2024, GAO report on U.S. domestic icebreaking performance stated

> The Coast Guard conducts domestic icebreaking operations in three of its nine districts—the Great Lakes, New England, and the Mid-Atlantic.
>
> In the Great Lakes, 55 percent of the regional economy is dependent on key shipping channels, according to the Coast Guard. In 2020, industries shipped 100 million tons of iron ore, limestone, coal, and other commodities through the Great Lakes, according to data from the Army Corps of Engineers Waterborne Commerce Statistics Center. Some industry stakeholders who rely on these shipping channels have raised questions about whether the Coast Guard has adequate icebreaking resources available to facilitate commerce.
>
> Section 11212 of the James M. Inhofe National Defense Authorization Act for Fiscal Year 2023 [H.R. 7776/P.L. 117-263 of December 23, 2022] includes a provision for GAO to review Coast Guard icebreaking operations in the Great Lakes and examine proposed performance standards for the Coast Guard's Great Lakes icebreaking program. This report discusses the associations between ice coverage on the Great Lakes and effects on certain economic indicators, the Coast Guard's icebreaking resource needs, and the potential effects of the proposed standards on the Coast Guard's icebreaking efforts.
>
> **Key Takeaways**
>
> - Great Lakes vessel-based commerce declines during the winter, primarily due to lock closures and weather conditions. We found that the amount of ice coverage on the Great Lakes was generally not associated with selected economic indicators we

Senate Appropriations Committee's report on S. 1619, the Department of Homeland Security Appropriations Bill, 2016 (see page 75).)

[49] Admiral Schultz expressed support for procuring an additional heavy Great Lakes icebreaker as part of a budget reconciliation bill as part of his testimony at an October 19, 2021, hearing on Coast Guard oversight before the Oceans, Fisheries, Climate Change, and Manufacturing subcommittee of the Senate Commerce, Science, and Transportation Committee. For the transcript of his remarks on this point, see **Appendix C**.

[50] Government Accountability Office, *Coast Guard: Improved Reporting on Domestic Icebreaking Performance Could Clarify Resource Needs and Tradeoffs*, GAO-24-106619, January 16, 2024, Table 1 on page 8. In a footnote to the table, GAO states that "the actual costs [for items shown in the table] are likely to be higher than reported because the estimates do not include other costs, such as shore infrastructure costs at port locations that the Coast Guard has not yet determined."

examined, such as regional unemployment rates and unfilled orders for steel production. Industries may mitigate the effects of delays caused by ice coverage, such as stockpiling iron ore inventory to maintain steel production throughout the winter.

- The Coast Guard identified heavy icebreaking capability gaps and its reliance on an aging fleet as risks to its ability to conduct its domestic icebreaking mission. As a result, the Coast Guard anticipates needing at least $3 billion in lifecycle costs to replace and acquire new vessels for domestic icebreaking.
- The proposed standards for the Coast Guard's domestic icebreaking program will largely not have an operational impact. The proposed standards may lead to improvements in data collection and reporting, which could help the Coast Guard better communicate its resource needs and tradeoffs. However, the data collection efforts may increase operating costs and information sharing needs with industry, according to the Coast Guard.
- We recommend that the Coast Guard, using data it already collects, report more complete information on its icebreaking performance to better articulate its resource needs and tradeoffs.[51]

Issues for Congress

CAPI Program: Total Cost to Purchase and Modify

One potential issue for Congress concerns the total cost to purchase a commercially available polar icebreaker (CAPI) and modify it for use as a Coast Guard polar icebreaker. Potential oversight questions for Congress include the following:

- Is the $125.0 million in FY2024 procurement funding provided for the CAPI program intended to cover the total estimated cost to purchase the ship and make all modifications needed to meet the Final Operational Capability (FOC) requirements for the ship? If not, how much additional funding does the Coast Guard anticipate requesting in subsequent fiscal years for completing the modifications needed to meet the FOC requirements?

The Coast Guard's FY2025 unfunded priorities list (UPL) includes an item for $25.0 million in procurement funding for CAPI "for survey and design activities, modifications, and integrated logistics support required to advance towards full operational capability."[52]

PSC Program: Delay in Construction and Delivery of First Ship

Another potential issue for Congress concerns the delay in the construction start and delivery date of the first PSC. The Coast Guard originally aimed to have the first PSC delivered in 2024, but the ship's estimated delivery date has been delayed repeatedly. An April 2023 GAO report states that as of August 2022, about 41% of the ship's overall design had been completed,[53] raising a question as to how much time the use of the German parent design has in practice saved in designing the PSC.

[51] Government Accountability Office, *Coast Guard: Improved Reporting on Domestic Icebreaking Performance Could Clarify Resource Needs and Tradeoffs*, GAO-24-106619, January 16, 2024, pp. 1-2.

[52] U.S. Coast Guard, *FY 2025 Unfunded Priorities List, Report to Congress*, March 11, 2024, p. 2.

[53] Government Accountability Office, *DHS Annual Assessment[:] Major Acquisition Programs Are Generally Meeting Goals, but Cybersecurity Policy Needs Clarification*, GAO-23-106701, April 2023, p. 51.

Given the degree of design completion as of August 2022, construction of the ship might begin no earlier than 2024. A July 2023 GAO report on the PSC states that construction of the first PSC is planned to start in March 2024.[54] If construction of the first ship begins in 2024, and if the ship takes at least four years to build, which might be a reasonable estimate for building a lead ship (i.e., first ship in the class) of the PSC's size and complexity, then the first PSC might be delivered no earlier than 2028.

At a July 13, 2023, hearing on the Coast Guard's budget before the Oceans, Fisheries, Climate Change and Manufacturing subcommittee of the Senate Commerce, Science, and Transportation Committee, Admiral Fagan stated that

> The shipyard that the contract was awarded to was recently purchased and is now owned by Bollinger Mississippi.
>
> We're working with the owner [Bollinger] on accelerating [the] detailed design [work on the ship], understanding what the—and definitizing the schedule and any implications with regard to new cost estimates. I was at that yard just a few weeks ago. They've welded, so a test coupon [sic]. I am confident we are going to begin building that ship as we go into the next calendar year, early in the next calendar year [i.e., early in 2024].
>
> It'll be at least a four-year project to build that ship, and I understand that that puts [the availability the first PSC for Operation] Deep Freeze 2028[55] potentially at risk, but we continue to engage with the shipyard and with the leadership there to accelerate into the work that is critical to getting that ship building begun and then fielding and executing it on behalf of the nation.[56]

An April 6, 2023, press report states that Bollinger

> is expected to begin working on production-related prototype efforts soon that will help inform the ongoing detailed design of the first new U.S. heavy polar icebreaker in decades and hopefully put the company in a position to give a timeline late this summer or early fall on when construction of the ship will begin, a senior Coast Guard official [Vice Admiral Steven Poulin, the vice commandant of the Coast Guard] said this week.[57]

A January 22, 2024, press report states

> U.S. Navy programs have made recent headlines for falling behind schedule. Now, Coast Guard officials say their service, too, fears several of its acquisition programs are at risk of delays, as four separate shipbuilders vie for limited workers along the Gulf Coast.
>
> Rear Adm. Chad Jacoby, the assistant commandant of the Coast Guard for acquisition, said this month workforce challenges—specifically, needing more highly trained welders and design engineers—are contributing to delays on the Polar Security Cutter program at Bollinger Mississippi, formerly VT Halter Marine.
>
> "If you look across all of our construction programs, every shipyard says they're going to hire 1,000 or 2,000 more people prior to executing the contracts that we have in place. They all happen to be on the Gulf Coast, so if you add up all those numbers, it's probably

[54] Government Accountability Office, *Coast Guard Acquisitions[:] Polar Security Cutter Needs to Stabilize Design Before Starting Construction and Improve Schedule Oversight*, GAO 23-105949, July 2023, highlights page.

[55] As noted earlier, Operation Deep Freeze is an annual Coast Guard polar icebreaker mission to break through Antarctic sea ice so as to reach and resupply McMurdo Station, the large U.S. Antarctic research station located on the shore of McMurdo Sound, near the Ross Ice Shelf.

[56] Source: CQ transcript of hearing. See also Cal Biesecker, "Fagan Suggests Further Delay In Polar Security Cutter," *Defense Daily*, July 13, 2023.

[57] Cal Biesecker, "Coast Guard Hoping For Updated Icebreaker Production Timeline From Bollinger Later This Year," *Defense Daily*, April 6, 2023.

> physically impossible for every one of those individual shipyards to hire 2,000 more people" to support on-time ship deliveries, Jacoby said on a Jan. 11 panel at the Surface Navy Association annual conference.
>
> He told Defense News after the panel he is specifically concerned about Bollinger Mississippi in Pascagoula and its Polar Security Cutter; Eastern Shipbuilding Group in Panama City, Florida, which is building the first four Offshore Patrol Cutters; Austal USA in Mobile, Alabama, which will build the next 11 OPCs; and Birdon America, a Denver-based company that will build the Waterways Commerce Cutters with a number of Louisiana- and Alabama-based companies.
>
> "It is one workforce across many states," the admiral said of the Gulf Coast region. "As each shipyard says they're going to hire people, they're definitely competing against each other."[58]

A March 20, 2024, press report states:

> The Coast Guard is currently working with the shipbuilder, Bollinger Shipyards, to "rebaseline [the program]," which will result in a new program schedule that is expected to be completed "later this year and will be critical to informing future budget requests," a service spokesperson wrote in an email….
>
> … the reevaluation of the program means that the entire program schedule will be revamped, and that schedule will not be made available until later this year, the service said.[59]

See also the comments about the first ship's delivery date from the GAO testimony and reports discussed in the following section.

PSC Program: Technical, Schedule, and Cost Risk

Another potential issue for Congress—one that includes but extends beyond the issue discussed above of the delay in the construction and delivery of the first ship—concerns technical, schedule, and cost risk in the PSC program in general.

Parent Design and PSC Design

One potential aspect of the issue of technical, schedule, and cost risk in the PSC program relates to the parent design for the PSC design. As mentioned earlier

- A key aim in using the parent design approach is to reduce cost, schedule, and technical risk in the PSC program.
- Halter Marine stated that its winning design for the PSC "is an evolution from the mature 'Polar Stern II' [German icebreaker] currently in design and construction; the team has worked rigorously to demonstrate its maturity and reliability."
- Halter Marine and ship designer Technology Associates, Inc. reportedly made "a lot of modifications" and went through six design spirals to refine the PSC's design.
- An April 2023 GAO report stated: "Design maturity continues to be a top risk identified by the program. Coast Guard officials stated that, as of August 2022, Halter Marine, Inc., had completed about 41 percent of the overall design."

[58] Megan Eckstein, "Coast Guard Ship Programs Facing Delays amid National Worker Shortage," *Defense News*, January 22, 2024.

[59] Allyson Park, "Coast Guard Reevaluating Polar Security Cutter Schedule," National *Defense*, March 20, 2024.

Some observers have questioned the value of using parent designs in military shipbuilding programs. A 2015 journal article, for example, states

> The U.S. Navy has experimented with many approaches to design and build its ships. Using an existing design as the "parent" design, also referred to as "modified-repeat" design, is on its face an attractive option. Many acquisition executives, program managers and some ship design engineers believe that a design based on a parent has fewer technical risks than a new "clean sheet of paper" design and therefore the time and cost to design and build it will be reduced. They assume early in the ship acquisition program that "the design is mature" and because of that fewer problems will be encountered in completing the design and savings will thus be accrued. Yet, a number of naval ships based on a parent design have in fact experienced unanticipated cost and schedule growth during construction as well as technical problems during their in-service life. The authors will examine some of these ship designs which were based on an existing design and/or prototypes and highlight the fallacies of such beliefs and assumptions. The authors will also briefly describe the development and use of more physics-based design tools during early stage design that can reduce the risks of a new clean sheet ship design through design space exploration and actual design maturation.[60]

Potential oversight questions for Congress include the following:

- How fully developed was *Polarstern II's* design at the time that it was adopted as the parent design for developing the PSC design? How much of *Polarstern II's* detail design and construction plan was completed at that time?
- To what degree has *Polarstern II's* design in practice served as the parent design for the PSC design? In developing the PSC's design, how many changes have been made from *Polarstern II's* design? What technical, schedule, and cost risks, if any, might arise for the PSC program as a result of differences between the PSC's design and *Polarstern II's* design?

Accuracy of Estimated Procurement Cost Given Ship's Size and Complexity

Another potential aspect of the issue of technical, schedule, and cost risk in the PSC program concerns the accuracy of the PSC's estimated procurement cost, given the PSC's size and internal complexity as well as cost growth in other Navy and Coast Guard shipbuilding programs. As shown in **Table 1**, as of August 2020, the total procurement cost of the first three PSCs was estimated at $2,673 million, or an average of $891 million per ship. Cost growth that has occurred in other Navy and Coast Guard shipbuilding programs can raise a question regarding the potential for cost growth in the PSC program due to underestimation of intrinsic building costs, inflation, or other causes. If a substantial degree of cost growth occurs in the PSC program, it could raise a question regarding whether to grant some form of contract relief to the PSC shipbuilder, as occurred in the OPC program.[61]

[60] Robert G. Keane, Jr. and Barry F. Tibbitts, "The Fallacy of Using a Parent Design: 'The Design Is Mature,'" *Transactions (Society of Naval Architects and Marine Engineers [SNAME])*, 2015, No. 1 (January): 91-104, with additional discussion from the authors and other commentators on pages 105-122. The quoted passage appears at the start of the article, on page 91, where it forms part of an abstract or summary for the article.

[61] For more on the contract relief granted in the OPC program, which was done under the authority provided by P.L. 85-804 (50 U.S.C. 1431-1435), see CRS Report R42567, *Coast Guard Cutter Procurement: Background and Issues for Congress*, by Ronald O'Rourke.

Cost Per Weight

Ship designs of broadly similar size and internal complexity that are built at the same time in shipyards that are located in the same country can have construction costs roughly proportional to their displacements (i.e., weights). In that connection, the following can be noted:

- The PSC's estimated procurement cost per weight is roughly half that of the Navy's LPD-17 Flight II and LHA amphibious ships.[62] These amphibious ships are equipped with expensive combat system equipment that is not included in the PSC design, but whether this would account for all of the difference in cost per weight between the PSC design and the two amphibious ship designs is not clear.
- The PSC's estimated procurement cost per weight is roughly one-half greater than that of the Navy's John Lewis (TAO-205) class oilers.[63] The PSC design includes internal equipment not included in the TAO-205 design, but whether this difference is fully reflected in the PSC's estimated procurement cost per weight is again not clear.

Recently Reported Cost Growth on Other Navy and Coast Guard Ships

Cost growth in other Navy and Coast Guard shipbuilding programs reported in the Navy's FY2024 budget submission and a June 2023 GAO report includes the following:

- about 10% growth since the Navy's FY2023 budget submission in estimated unit procurement costs for Navy Virginia-class attack submarines;[64]
- about 40% growth between 2012 and 2022 in the estimated the total program acquisition cost of the Coast Guard's Offshore Patrol Cutter (OPC) program;[65]
- about 51% growth since the Navy's FY2021 budget submission in estimated unit procurement costs for Navy John Lewis (TAO-205) class oilers;[66] and

[62] Source: CRS calculation based on PSC, LPD-17 Flight II, and LHA procurement costs and displacements. For more on the LPD-17 Flight II and LHA programs, see CRS Report R43543, *Navy LPD-17 Flight II and LHA Amphibious Ship Programs: Background and Issues for Congress*, by Ronald O'Rourke.

[63] Source: CRS calculation based on PSC and TAO-205 class procurement costs and displacements. For more on the TAO-205 program, see CRS Report R43546, *Navy John Lewis (TAO-205) Class Oiler Shipbuilding Program: Background and Issues for Congress*, by Ronald O'Rourke.

[64] The estimated unit procurement cost of Virginia-class attack submarines to be procured in FY2025-FY2027 is about 10% higher in the Navy's FY2024 budget submission than in the Navy's FY2023 budget submission. For more on the Virginia-class program, see CRS Report RL32418, *Navy Virginia (SSN-774) Class Attack Submarine Procurement: Background and Issues for Congress*, by Ronald O'Rourke.

[65] A June 2023 GAO report on the OPC program states: "The OPC's total acquisition cost estimate increased from $12.5 billion to $17.6 billion between 2012 and 2022. The program attributes the 40 percent increase to many factors, including restructuring the stage 1 contract [for OPCs 1 through 4] and recompeting the stage 2 requirement [for OPCs 5 through 15] in response to a disruption caused by Hurricane Michael, and increased infrastructure costs for homeports and facilities, among other things." (Government Accountability Office, *Coast Guard Acquisitions[:] Offshore Patrol Cutter Program Needs to Mature Technology and Design*, GAO 23-105805, June 2023, highlights page.) For more on the OPC program, see CRS Report R42567, *Coast Guard Cutter Procurement: Background and Issues for Congress*, by Ronald O'Rourke.

[66] In the Navy's FY2021 budget submission, the four TAO-205s programmed for procurement during the five-year period FY2021-FY2025 had an average estimated procurement cost of $556.9 million per ship, while in the Navy's FY2024 budget submission, the six TAO-205s programmed for procurement during the five-year period FY2024-FY2028 have an average estimated procurement cost of $843.4 million, a figure that is 51% greater. For more on the TAO-205 program, see CRS Report R43546, *Navy John Lewis (TAO-205) Class Oiler Shipbuilding Program: Background and Issues for Congress*, by Ronald O'Rourke.

- about 82% growth since FY2022 in the estimated unit procurement cost of the Navy's first TAGOS-25 class ocean surveillance ship.[67]

Some of the cost growth shown above may be due to inflation resulting from covid-related disruptions to supply chains, some may be due to optimistic estimates of the intrinsic costs for building these ships, and some may be due to other causes.

July 2023 GAO Testimony

July 27, 2023, GAO testimony to the Coast Guard and Maritime Transportation subcommittee of the House Transportation and Infrastructure Committee regarding the PSC program and the Coast Guard's Offshore Patrol Cutter (OPC) program[68] states

> The Coast Guard's shipbuilding programs—specifically the OPC and PSC programs—have struggled with achieving elements for a good business case. As a result of neither maturing technologies nor achieving design stability when called for by leading practices, both programs are well behind schedule. In addition, both programs' cost estimates have increased by billions of dollars for several reasons, including that their initial estimates were either not comprehensive or not well-informed.
>
> **Technology maturity and design stability.** The Coast Guard's OPC and PSC programs did not follow shipbuilding leading practices with regards to conducting, demonstrating, and achieving technology readiness and design stability….
>
> Years after we first identified these deficiencies with the OPC and PSC programs, the Coast Guard still has not gained the requisite knowledge for its technologies and designs:…
>
> • **PSC:** In September 2018, we found that the Coast Guard did not conduct a technology readiness assessment of PSC's key technologies, nor did it hold a preliminary design review, prior to approving its program baselines. Coast Guard officials said that a technology readiness assessment was not necessary because the technologies they plan to employ had been proven on other ships. However, according to leading practices, such technologies can still pose risks when applied to a different program or operational environment. The program subsequently conducted a technology readiness assessment and established revised baselines in May 2021 after holding its preliminary design review in response to our recommendations.
>
> As of March 2023, the PSC program reported that the functional design was considerably below the desired levels that officials expect to inform a decision to proceed with construction. As of April 2023, program officials said they anticipate holding the production readiness reviews to evaluate design maturity by March 2024. However, since September 2021, with about 49 percent functional design completed, our analysis indicated that the shipyard is completing, on average, approximately three percent of functional design every 6 months. This means that it would take the shipyard approximately 8 years to complete 100 percent of functional design. Therefore, to reach the program's goal of completing functional design completed prior to March 2024, the shipyard would need to increase its design completion rate significantly. Coast Guard officials said that design completion is further along than the metrics show because the metrics do not factor in progress made on design components that are not complete.

[67] The Navy in FY2022 procured the first of a planned class of seven new TAGOS-25 class ocean surveillance ships at a cost of $434.4 million. The Navy's FY2024 budget submission shows that the ship's estimated procurement cost has since grown to $789.6 million—an increase of $355.2 million, or 81.8%. For more on the TAGOS-25 program, see CRS In Focus IF11838, *Navy TAGOS-25 (Previously TAGOS[X]) Ocean Surveillance Shipbuilding Program: Background and Issues for Congress*, by Ronald O'Rourke.

[68] For more on the OPC program, see CRS Report R42567, *Coast Guard Cutter Procurement: Background and Issues for Congress*, by Ronald O'Rourke.

We also found that the program is experiencing challenges with the design. According to program officials, the design challenges are related to (1) U.S. industry's general lack of experience designing and building icebreakers, (2) the complexity of PSC's design, and (3) significant changes from the original design, among other things. Given that there are still portions of the design that are immature, we recommended that the Coast Guard complete functional design prior to approving construction for the lead ship, in line with our recommendation to OPC and Coast Guard policy, as a whole. The Coast Guard concurred with the recommendations, and we will monitor its progress in addressing them.

Cost. Both the OPC and PSC have incurred cost growth above their initial estimates, in part because the programs initially underestimated costs….

• **PSC:** From 2018 to 2021, the program's total life-cycle cost estimate increased by about 35 percent, from $9.8 billion to $13.3 billion. Most of the cost increase was driven by increased operations and maintenance costs, resulting from the increased ship size and use of additional historical data to reevaluate projected annual maintenance costs in the later estimate. The program's additional analysis of historical maintenance costs in its January 2021 cost estimate addressed, in part, a recommendation we made in 2018 to update the cost estimate in accordance with leading practices in cost estimating. Specifically, in September 2018, we found that the PSC's life-cycle cost estimate that informed the program's $9.8 billion cost baseline substantially met GAO's leading practices for being comprehensive, well-documented, and accurate, but only partially met leading practices for being credible.15 The cost estimate did not quantify the range of possible costs over the entire life of the program. As a result, the cost estimate was not fully reliable and may have underestimated the cost. Consequently, the Coast Guard may have provided decision makers with incomplete data to make a decision on total funding needed for the program.

Schedule. The Coast Guard relied on optimistic schedules for both the PSC and OPC programs, and both have experienced schedule delays of 2 years or more…. The two programs' schedule challenges have been exacerbated by a lack of reliable schedule data from the contractors responsible for building these ships….

• **PSC:** In September 2018, we found that the PSC's planned delivery dates were not informed by a realistic assessment of shipbuilding activities. Instead, the schedule was driven by the potential gap in icebreaking capabilities once the Coast Guard's only operating heavy polar icebreaker—the Polar Star—reaches the end of its service life. We recommended that the program develop a schedule in accordance with leading practices for project schedules to set realistic schedule goals for all three PSCs before the lead ship contract option was awarded. However, we closed the recommendation as not implemented because the program proceeded with the award in April 2019 without developing a realistic schedule. In July 2023, we found the program had yet to establish a realistic schedule. The program's current schedule estimates that delivery of the lead ship will occur in 2027, which is 3 years later than its previous estimate, but this could further slip after the contractor reassesses and revises its schedule.[69]

July 2023 GAO Report

A GAO report on the PSC program that was released on July 27, 2023, similarly states

> The Polar Security Cutter's (PSC) design is not yet mature, which has led to an extended design phase and contributed to a 3-year schedule delay in the shipyard, with construction of the first cutter now planned for March 2024. Coast Guard officials attribute the extended

[69] Government Accountability Office, *Coast Guard Recapitalization[:] Actions Needed to Better Manage Acquisition Programs and Address Affordability Concerns*, Statement of Marie A. Mak, Director, Contracting and National Security Acquisitions, Testimony Before the Subcommittee on Coast Guard and Maritime Transportation, Committee on Transportation and Infrastructure, House of Representatives, July 27, 2023, GAO 23-106948, pp. 6-12.

design phase to various challenges. For example, icebreaking hulls require thick steel—up to twice as thick as a non-icebreaker—and a dense framing structure that has been challenging to plan for the PSC. Additionally, Coast Guard officials stated that U.S.-based shipbuilders have limited expertise designing and building heavy polar icebreakers….

Starting construction with an immature design is contrary to leading practices. In another ongoing Coast Guard program, GAO found that construction started before the design was mature, resulting in costly rework and schedule delays.

The PSC program likely has unreliable schedule and cost estimates. The primary reasons are:

• The acquisition program baseline includes a delivery date for the first PSC but not for the third PSC. At a minimum, without a delivery date for the third cutter, the Department of Homeland Security (DHS) may have fewer opportunities for oversight if the program experiences schedule delays in the years before the program is expected to be declared fully operational.

• Key shipyard business systems that track labor hours, costs, and schedule performance were determined not to be acceptable for use, which affects the reliability of data. The Coast Guard and shipyard are taking steps to address the data limitations and GAO will continue to monitor progress.

The Coast Guard intends for its sole remaining, almost 50-year-old heavy polar icebreaker, the Polar Star, to be available until at least the second PSC is operational. The Coast Guard has efforts underway to maintain and extend the life of this cutter. However, the Polar Star's deteriorating systems present challenges, with top issues related to propulsion and electrical systems. The Coast Guard's assessments of the hull found it in good structural condition.[70]

April 2023 GAO Report

A GAO report that was released on April 20, 2023, and which reports on the status of major DHS acquisition programs as of September 30, 2022, states the following about the PSC program:

Key Findings

• Schedule. The program no longer considers a May 2025 delivery date for the lead ship realistic. However, the program does not have enough information from the shipbuilder to determine a new delivery date or whether schedule goals will likely be breached.

• Design and construction. Design immaturity and the shipbuilder's inexperience working with the specialized steel needed for hull construction remain the program's top risks, according to program officials. To help train the shipbuilder's workforce, the program is planning for an early production phase prior to completion of the design, contrary to GAO leading practices. The critical design review, scheduled for December 2022, will likely need to be postponed given the status of design progress.

• **Management.** Oversight of the program is hampered. The shipbuilder's deficient business systems are not producing reliable accounting, schedule, and cost data. The Coast Guard is working with the shipbuilder to address these challenges....

Cost and Schedule Status

In 2021, DHS approved PSC's revised acquisition program baseline (APB), which reflected a delayed schedule and higher life-cycle costs than the previously approved 2018 APB. However, as of August 2022, Coast Guard officials stated that they do not have

[70] Government Accountability Office, *Coast Guard Acquisitions[:] Polar Security Cutter Needs to Stabilize Design Before Starting Construction and Improve Schedule Oversight*, GAO 23-105949, July 2023, highlights page.

reliable schedule information from the shipbuilder, Halter Marine, Inc., to determine whether it is likely to breach the schedule goals. For example, the contract delivery date for the lead ship is May 2025, which is 1 year later than initially planned. However, officials stated that May 2025 is no longer realistic because of challenges such as COVID-19 effects and the shipbuilder's inexperience with large government acquisitions. The program does not have enough information to determine and assess a new delivery date until Halter Marine, Inc., develops a new schedule, anticipated by March 2023. The program requested an adjustment to its schedule goals due to the effects of COVID-19 and is awaiting DHS approval.

According to Coast Guard officials, the program's top schedule risks are PSC's design immaturity, Halter Marine, Inc.'s inexperience with shaping the specialized steel needed for the hulls, and Halter Marine, Inc.'s contractor labor challenges. Coast Guard officials stated they are mitigating some of these risks by conducting studies on the specialized steel and planning for an early production phase. This phase will allow the shipbuilder to start constructing up to eight (out of 85) selected modules of the ship deemed to be low-risk prior to completing the ship's design. While this approach is intended to train the shipbuilder's workforce in working with the steel, starting construction prior to completing design is contrary to shipbuilding leading practices identified by GAO. If design changes are discovered after the modules are already constructed, the program may face costly rework and schedule delays.

Coast Guard officials stated that the program's main tool in mitigating cost risks is the contract type for design and construction of the cutters—fixed-price incentive (firm-target) with economic price adjustment. This type of contract provides the shipbuilder with an incentive to control costs.

Performance and Testing

Design maturity continues to be a top risk identified by the program. Coast Guard officials stated that, as of August 2022, Halter Marine, Inc., had completed about 41 percent of the overall design. The program had planned to conduct a critical design review by December 2022 to further evaluate design maturity. However, Coast Guard officials stated that given the design progress, they will likely postpone the review to anywhere from May to December 2023. Coast Guard officials stated that they do not plan to authorize Halter Marine, Inc., to enter into the early production phase until after an initial critical design review and designs for the selected modules are mature.

Coast Guard officials stated that the program conducted a cyber resilience early operational assessment in May 2022 and deemed the results as sensitive. Coast Guard officials established two working groups to address cybersecurity issues, and cyber risks are managed as part of the program's risk management team.

Program Management

The Coast Guard established an integrated program office and ship design team with the Navy. The Coast Guard also established a project residence office at the shipbuilder's facility in Pascagoula, Mississippi, to provide oversight of shipbuilding efforts. However, the shipbuilder's deficient business systems are hindering the Coast Guard's oversight of the program. In June 2022, an independent audit found that Halter Marine, Inc.'s accounting system had significant deficiencies that affected the reliability of billing and pricing information produced. Further, in July 2022, an independent compliance review found that Halter Marine, Inc.'s earned value management system had significant deficiencies that hampers the program's ability to monitor cost and schedule progress and develop a reliable schedule. Coast Guard officials stated that they are working with Halter Marine, Inc., to address these deficiencies.

In September 2018, GAO made six recommendations to DHS, the Coast Guard, and the U.S. Navy to address risks identified with the PSC program. As of September 2022, two

of the six recommendations remain open. For additional information, see [GAO report] GAO-18-600.[71]

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. According to the program office, the PSC is the first heavy polar icebreaker built in the U.S. in over 40 years and will be one of the most complex vessels ever built by the Coast Guard. Program officials stated that they have worked closely with the shipbuilder to mature the design of the ship and mitigate production risk. Officials added that ongoing challenges with supply chain disruptions and COVID-19 have affected this effort.[72]

PSC Program: Contract with Options vs. Block Buy Contract

Another potential issue for Congress is whether to use a contract with options or a block buy contract to acquire at least some of the PSCs. The DD&C contract that the Coast Guard awarded to Halter Marine is a contract with options. Coast Guard and Navy officials, however, have expressed openness to the idea of using a block buy contract to acquire at least some of the ships (particularly the second and third PSCs), and requested information on the possibility of using block buy contracting as part of the request for proposals (RFP) for the PSC program that the Coast Guard released on March 2, 2018. Section 311 of the Frank LoBiondo Coast Guard Authorization Act of 2018 (S. 140/P.L. 115-282 of December 4, 2018) provides permanent authority for the Coast Guard to use block buy contracting with economic order quantity (EOQ) purchases (i.e., up-front batch purchases) of components in its major acquisition programs. The authority is now codified at 14 U.S.C. 1137.

Although a contract with options covers multiple years, it operates more like a form of annual contracting, and it does not generate the kinds of savings that are possible with a block buy contract. Compared with a contract with options, a block buy contract would reduce the government's flexibility regarding whether and when to acquire the second and third ships, and what design to build them to,[73] and in return reduce the combined acquisition cost of the ships covered by the contract. The Navy has used block buy contracts to reduce procurement costs of Virginia-class attack submarines and (in more recent years) Littoral Combat Ships (LCSs) and John Lewis (TAO-205) class oilers.[74] Compared to costs using a contract with options, using a

[71] Government Accountability Office, *Coast Guard Acquisitions[:] Polar Icebreaker Program Needs to Address Risks before Committing Resources*, GAO-18-600, September 2018, 68 pp.

[72] Government Accountability Office, *DHS Annual Assessment[:] Major Acquisition Programs Are Generally Meeting Goals, but Cybersecurity Policy Needs Clarification*, GAO-23-106701, April 2023, pp. 50-51.

[73] Stated more fully, from a congressional perspective, trade-offs in using block buy contracting include the following:

—reduced congressional control over year-to-year spending, and tying the hands of future Congresses;

—reduced flexibility for making changes in Coast Guard acquisition programs in response to unforeseen changes in strategic or budgetary circumstances (which can cause any needed funding reductions to fall more heavily on acquisition programs not covered by multiyear contracts);

—a potential need to shift funding from later fiscal years to earlier fiscal years to fund economic order quantity (EOQ) purchases (i.e., up-front batch purchases) of components;

—the risk of having to make penalty payments to shipbuilders if multiyear contracts need to be terminated due to unavailability of funds needed to the continue the contracts; and

—the risk that materials and components purchased for ships to be acquired in future years might go to waste if those ships are not eventually acquired.

[74] See CRS Report R41909, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*, by Ronald O'Rourke; CRS Report RL33741, *Navy Littoral Combat Ship (LCS)* (continued...)

block buy contract that included economic order quantity (EOQ) purchases (i.e., up-front batch purchases) of materials and components for three heavy polar icebreakers could reduce the combined acquisition cost of three PSCs by a few or several percent.

A congressionally mandated July 2017 National Academies of Sciences, Engineering, and Medicine (NASEM) report on acquisition and operation of polar icebreakers states the following (emphasis as in original):

> **3. Recommendation: USCG should follow an acquisition strategy that includes block buy contracting with a fixed price incentive fee contract and take other measures to ensure best value for investment of public funds.**
>
> Icebreaker design and construction costs can be clearly defined, and a fixed price incentive fee construction contract is the most reliable mechanism for controlling costs for a program of this complexity. This technique is widely used by the U.S. Navy. To help ensure best long-term value, the criteria for evaluating shipyard proposals should incorporate explicitly defined lifecycle cost metrics....
>
> A block buy authority for this program will need to contain specific language for economic order quantity purchases for materials, advanced design, and construction activities. A block buy contracting program with economic order quantity purchases enables series construction, motivates competitive bidding, and allows for volume purchase and for the timely acquisition of material with long lead times. It would enable continuous production, give the program the maximum benefit from the learning curve, and thus reduce labor hours on subsequent vessels....
>
> If advantage is taken of learning and quantity discounts available through the recommended block buy contracting acquisition strategy, the average cost per heavy icebreaker is approximately $791 million, on the basis of the acquisition of four ships.[75]

Section 8111 of the Elijah E. Cummings Coast Guard Authorization Act of 2020 (Division H/Division G of FY2021 National Defense Authorization Act [H.R. 6395/P.L. 116-283]) states

> SEC. 8111. POLAR ICEBREAKERS.
>
> (a) IN GENERAL.—Section 561 of title 14, United States Code, is amended to read as follows:
>
> ''§ 561. Icebreaking in polar regions
>
> ''(a) PROCUREMENT AUTHORITY.—
>
> ''(1) IN GENERAL.—The Secretary may enter into one or more contracts for the procurement of—
>
> ''(A) the Polar Security Cutters approved as part of a major acquisition program as of November 1, 2019; and
>
> ''(B) 3 additional Polar Security Cutters.
>
> ''(2) CONDITION FOR OUT-YEAR CONTRACT PAYMENTS.—A contract entered into under paragraph (1) shall provide that any obligation of the United States to make a payment under the contract during a fiscal year after fiscal year 2019 is subject to the availability of appropriations or funds for that purpose for such later fiscal year.

Program: Background and Issues for Congress, by Ronald O'Rourke; and CRS Report R43546, *Navy John Lewis (TAO-205) Class Oiler Shipbuilding Program: Background and Issues for Congress*, by Ronald O'Rourke.

[75] National Academies of Sciences, Engineering, and Medicine, Division on Earth and Life Studies and Transportation Research Board, *Acquisition and Operation of Polar Icebreakers: Fulfilling the Nation's Needs*, Letter Report, with cover letter dated July 11, 2017, pp. 14, 15.

‘‘(b) PLANNING.—The Secretary shall facilitate planning for the design, procurement, maintenance, deployment, and operation of icebreakers as needed to support the statutory missions of the Coast Guard in the polar regions by allocating all funds to support icebreaking operations in such regions, except for recurring incremental costs associated with specific projects, to the Coast Guard.

‘‘(c) REIMBURSEMENT.—Nothing in this section shall preclude the Secretary from seeking reimbursement for operation and maintenance costs of the Polar Star, Healy, or any other Polar Security Cutter from other Federal agencies and entities, including foreign countries, that benefit from the use of those vessels.

‘‘(d) RESTRICTION.—

‘‘(1) IN GENERAL.—The Commandant may not—

‘‘(A) transfer, relinquish ownership of, dismantle, or recycle the Polar Sea or Polar Star;

‘‘(B) change the current homeport of the Polar Sea or Polar Star; or

‘‘(C) expend any funds—

‘‘(i) for any expenses directly or indirectly associated with the decommissioning of the Polar Sea or Polar Star, including expenses for dock use or other goods and services;

‘‘(ii) for any personnel expenses directly or indirectly associated with the decommissioning of the Polar Sea or Polar Star, including expenses for a decommissioning officer;

‘‘(iii) for any expenses associated with a decommissioning ceremony for the Polar Sea or Polar Star;

‘‘(iv) to appoint a decommissioning officer to be affiliated with the Polar Sea or Polar Star; or

‘‘(v) to place the Polar Sea or Polar Star in inactive status.

‘‘(2) SUNSET.—This subsection shall cease to have effect on September 30, 2022.

‘‘(e) LIMITATION.—

‘‘(1) IN GENERAL.—The Secretary may not expend amounts appropriated for the Coast Guard for any of fiscal years 2015 through 2024, for—

‘‘(A) design activities related to a capability of a Polar Security Cutter that is based solely on an operational requirement of a Federal department or agency other than the Coast Guard, except for amounts appropriated for design activities for a fiscal year before fiscal year 2016; or

‘‘(B) long-lead-time materials, production, or postdelivery activities related to such a capability.

‘‘(2) OTHER AMOUNTS.—Amounts made available to the Secretary under an agreement with a Federal department or agency other than the Coast Guard and expended on a capability of a Polar Security Cutter that is based solely on an operational requirement of such Federal department or agency shall not be treated as amounts expended by the Secretary for purposes of the limitation under paragraph (1).

‘‘(f) ENHANCED MAINTENANCE PROGRAM FOR THE POLAR STAR.—

‘‘(1) IN GENERAL.—Subject to the availability of appropriations, the Commandant shall conduct an enhanced maintenance program on the Polar Star to extend the service life of such vessel until at least December 31, 2025.

‘‘(2) AUTHORIZATION OF APPROPRIATIONS.—The Commandant may use funds made available pursuant to section 4902(1)(A), to carry out this subsection.

''(g) DEFINITIONS.—In this section:

''(1) POLAR SEA.—The term 'Polar Sea' means Coast Guard Cutter Polar Sea (WAGB 11).

''(2) POLAR STAR.—The term 'Polar Star' means Coast Guard Cutter Polar Star (WAGB 10).

''(3) HEALY.—The term 'Healy' means Coast Guard Cutter Healy (WAGB 20).''.

(b) CONTRACTING FOR MAJOR ACQUISITIONS PROGRAMS.—Section 1137(a) of title 14, United States Code, is amended by inserting ''and 3 Polar Security Cutters in addition to those approved as part of a major acquisition program on November 1, 2019'' before the period at the end.

(c) REPEALS.—

(1) COAST GUARD AND MARITIME TRANSPORTATION ACT OF 2006.—Section 210 of the Coast Guard and Maritime Transportation Act of 2006 (14 U.S.C. 504 note) is repealed.

(2) COAST GUARD AND MARITIME TRANSPORTATION ACT OF 2012.—Section 222 of the Coast Guard and Maritime Transportation Act of 2012 (Public Law 112–213) is repealed.

(3) HOWARD COBLE COAST GUARD AND MARITIME TRANSPORTATION ACT OF 2014.—Section 505 of the Howard Coble Coast Guard and Maritime Transportation Act of 2014 (Public Law 113–281) is repealed.

(4) FRANK LOBIONDO COAST GUARD AUTHORIZATION ACT OF 2018.—Section 821 of the Frank LoBiondo Coast Guard Authorization Act of 2018 (Public Law 115–282) is repealed.

PSCs and ASCs: Using a Common Design

Another potential issue for Congress is whether to procure the Coast Guard's envisioned fleet of PSCs (i.e., heavy polar icebreakers) and ASCs (i.e., medium polar icebreakers) to a common basic design. A congressionally mandated July 2017 report from the National Academies of Sciences, Engineering, and Medicine (NASEM) on the acquisition and operation of polar icebreakers concluded that notional operational requirements for new medium polar icebreakers would result in ships that would not be too different in size from new heavy polar icebreakers. (As shown in **Table A-1**, the Coast Guard's current medium polar icebreaker, *Healy*, is actually somewhat larger than the Coast Guard's heavy polar icebreaker, *Polar Star*.) Given what it concluded as the probable similarity in size between future U.S. heavy and medium polar icebreakers, the NASEM report recommended building a single medium polar icebreaker to the same common design as three new heavy polar icebreakers. This approach, the report concluded, would reduce the cost of the medium icebreaker by avoiding the cost of developing a new design and by making the medium polar icebreaker the fourth ship on an existing production learning curve rather than the first ship on a new production learning curve.[76] If policymakers were to

[76] National Academies of Sciences, Engineering, and Medicine, Division on Earth and Life Studies and Transportation Research Board, *Acquisition and Operation of Polar Icebreakers: Fulfilling the Nation's Needs*, Letter Report, with cover letter dated July 11, 2017, pp. 2, 4-6. See also Calvin Biesecker, "Coast Guard Leaving Options Open For Future Polar Icebreaker Fleet Type," *Defense Daily*, April 12, 2018. Section 8108 of the Elijah E. Cummings Coast Guard Authorization Act of 2020 (Division H/Division G of FY2021 National Defense Authorization Act [H.R. 6395/P.L. 116-283]) states

SEC. 8108. POLAR SECURITY CUTTER ACQUISITION REPORT.

(continued...)

decide to procure a second new ASC or a third new ASC, the same general approach recommended by the NASEM report could be followed—a second ASC and third ASC could be built to the same common design used for the three new PSCs and the first new ASC.

At a November 29, 2023, hearing before the House Homeland Security Committee on how U.S. Arctic strategy impacts homeland security, Vice Admiral Peter Gautier, Coast Guard Deputy Commandant for Operations, stated that the Coast Guard in coming years will need to have "a mix of heavy icebreakers like the *Polar Star* and the Polar Security Cutters that we're building now, and medium icebreakers like the *Healy* that have shallower drafts and can get into tighter spaces and shallower areas."[77] Procuring ASCs as ships that have shallower drafts than PSCs for getting into tighter spaces and shallower areas could make it difficult or impossible for PSCs and ASCs to be built to the same common design: A ship's draft is a basic design characteristic, and it might be difficult or impossible to reduce the PSC design's draft enough to meet the Coast Guard's desire to have ASCs be able to get into tighter spaces and shallower areas without making changes to the PSC design that would effectively make it a different design.

PSCs and ASCs: Using a Foreign Shipyard

Overview

Another potential issue for Congress concerns the possibility of building polar icebreakers for the U.S. Coast Guard in a foreign shipyard. Shipyards in Finland, for example, reportedly have expressed interest in building polar icebreakers for the U.S. Coast Guard.[78] Some observers believe the acquisition cost of Coast Guard polar security cutters could be reduced, perhaps substantially, by building them in a foreign shipyard, such as a shipyard in Finland or in one of the other Nordic countries that is experienced in building icebreakers. Other observers question whether icebreaker designs offered by foreign shipbuilders would meet (or be a cost-effective way of providing) the Coast Guard's desired capabilities for polar security cutters, which include capabilities for performing Coast Guard missions other than icebreaking. An October 9, 2017, press report states

> Finland, the world leader in icebreaker design and construction, could help pull the United States out of its icebreaker crisis, a diplomat said at a business conference in Anchorage last week.

> Not later than 1 year after the date of the enactment of this Act, the Commandant shall submit to the Committees on Transportation and Infrastructure and Armed Services of the House of Representatives, and the Committees on Commerce, Science, and Transportation and Armed Services of the Senate a report on—
>
> (1) the extent to which specifications, key drawings, and detail design for the Polar Security Cutter are complete before the start of construction;
>
> (2) the extent to which Polar Security Cutter hulls numbers one, two, and three are science ready; and
>
> (3) what actions will be taken to ensure that Polar Security Cutter hull number four is science capable, as described in the National Academies of Sciences, Engineering, and Medicine's Committee on Polar Icebreaker Cost Assessment letter report entitled ''Acquisition and Operation of Polar Ice breakers: Fulfilling the Nation's Needs'' and dated July 11, 2017.

[77] CQ transcript of hearing.

[78] See, for example, Yereth Rosen, "Can the U.S. Benefit from Finland and Russia's Icebreaker Expertise?" *Arctic Now*, October 9, 2017. See also Jim Paulin, "Finland Wants In On US Icebreaker Investment," *Alaska Dispatch News*, September 8, 2015.

> "The U.S. is now in dire straits about its own icebreaker fleet. They only have two and they are both seriously outdated. We can help," Stefan Lindstrom, Finland's Los Angeles-based consul general, said in a presentation at last week's Arctic Ambitions conference held by the World Trade Center of Alaska....
>
> If the U.S. makes a decision to buy a replacement from overseas, Finnish shipbuilders could respond quickly, Lindstrom said.
>
> In Finland, a shipyard can build and deliver a polar-class icebreaker within 24 months after a contract is signed—a sharp contrast, Lindstrom said, to the extended discussions that the U.S. Coast Guard and Congress have had over planning for potential new icebreakers.
>
> And the costs for a Finnish-designed and Finnish-built polar-class icebreaker is about 200 million to 220 million Euros ($235 [million] to [$]258 million), he said. That's far lower than the price tag being discussed in the US.
>
> "I have serious difficulties, however, understanding how you can pay a billion for an icebreaker that costs one-fifth of it if you order it from abroad," Lindstrom said. "But I'm not going to go into those political situations."[79]

It is unclear from the above-quoted remarks whether the €220-million polar-class icebreaker being referred to would qualify as a heavy, medium, or light polar icebreaker, or to what degree it would meet the Coast Guard's desired capabilities for polar security cutters, which include capabilities for performing Coast Guard missions other than icebreaking. Of the six Russian heavy polar icebreakers shown in **Table B-1** (all of which are nuclear-powered), four were built in Russia, while the other two—sister ships named *Taymyr* and *Vaygach* that entered service around 1989 and 1990—were mostly built in Finland and then moved to a Russian shipyard for the installation of their nuclear reactors. All other Finnish-built icebreakers shown in **Table B-1** (whether operated by Finland or other countries) could be considered, based on their brake horsepower (BHP), to be medium or light polar icebreakers.

Laws Relating to Building Ships in Foreign Shipyards

Some observers have suggested that a U.S. law known as the Jones Act prevents the U.S. Coast Guard from buying or operating a foreign-built polar icebreaker. The Jones Act, however, does not prevent the U.S. Coast Guard from buying or operating a foreign-built polar icebreaker.[80] Two other laws, however, are of note in connection with the idea of building a U.S. Coast Guard polar icebreaker in a foreign shipyard. One is 14 U.S.C. 1151, which states the following:

---

[79] Yereth Rosen, "Can the U.S. Benefit from Finland and Russia's Icebreaker Expertise?" *Arctic Now*, October 9, 2017.

[80] The Jones Act (Section 27 of the Merchant Marine Act of 1920, P.L. 66-261) applies to vessels transporting "merchandise" from one U.S. point to another U.S. point. It requires that such transportation be performed in U.S.-built vessels owned by U.S. citizens and registered in the United States; U.S. registration, in turn, requires that crew members be U.S. citizens. Merchandise is defined to include "merchandise owned by the U.S. Government, a State, or a subdivision of a State; and valueless material" (46 U.S.C. §55102). Merchandise is further defined at 19 U.S.C. §1401(c) to mean "goods, wares, and chattels of every description." It is the waterborne transportation of merchandise domestically that triggers the Jones Act. A vessel wishing to engage in such transportation would apply to the U.S. Coast Guard for a "coastwise endorsement." Thus, an icebreaker strictly performing the task it is designed for and not transporting cargo from one U.S. point to another would not be subject to the Jones Act.

The federal agency in charge of deciding what kind of maritime activity must comply with the Jones Act, U.S. Customs and Border Protection (CBP), has confirmed that icebreaking is not one of those activities. In a 2006 ruling, which appears to be its most recent ruling on the subject, CPB informed Alcoa, Inc. that it could use foreign-built and foreign-flagged vessels for icebreaking on the Hudson River in New York State. CBP reasoned that the transporting of equipment, supplies, and materials used on or from the vessel in effecting its service is not coastwise trade, provided that these articles are necessary for the accomplishment of the vessel's mission and are usually carried aboard the vessel as a matter of course. The 2006 ruling cited earlier rulings in 1974, 1985, and 2000 as precedent.

> §1151. Restriction on construction of vessels in foreign shipyards
>
> (a) Except as provided in subsection (b), no Coast Guard vessel, and no major component of the hull or superstructure of a Coast Guard vessel, may be constructed in a foreign shipyard.
>
> (b) The President may authorize exceptions to the prohibition in subsection (a) when the President determines that it is in the national security interest of the United States to do so. The President shall transmit notice to Congress of any such determination, and no contract may be made pursuant to the exception authorized until the end of the 30-day period beginning on the date the notice of such determination is received by Congress.

The other is 10 U.S.C. 8679, which states the following:

> §8679. Construction of vessels in foreign shipyards: prohibition
>
> (a) Prohibition.-Except as provided in subsection (b), no vessel to be constructed for any of the armed forces,[81] and no major component of the hull or superstructure of any such vessel, may be constructed in a foreign shipyard.
>
> (b) Presidential Waiver for National Security Interest.-(1) The President may authorize exceptions to the prohibition in subsection (a) when the President determines that it is in the national security interest of the United States to do so.
>
> (2) The President shall transmit notice to Congress of any such determination, and no contract may be made pursuant to the exception authorized until the end of the 30-day period beginning on the date on which the notice of the determination is received by Congress.
>
> (c) Exception for Inflatable Boats.-An inflatable boat or a rigid inflatable boat, as defined by the Secretary of the Navy, is not a vessel for the purpose of the restriction in subsection (a).

Legislative Activity for FY2024 and FY2025

Summary of Appropriation Action on FY2024 Funding Request

Table 3 summarizes congressional appropriation action on the Coast Guard's FY2024 procurement funding requests for icebreakers.

Table 3. Summary of Congressional Appropriations Action on FY2024 Procurement Funding Request

(In millions of dollars)

	Request	HAC	SAC	Enacted
Polar Security Cutter (PSC)	170.0	144.194	0	0
Commercially available polar icebreaker (CAPI)	125.0	125.0	0	125.0
Commercially available polar icebreaker (CAPI) (emergency)	0	0	125.0	0
Great Lakes icebreaker (GLIB)	55.0	55.0	0	20.0
Great Lakes icebreaker (GLIB) (emergency)	0	0	55.0	0

[81] 14 U.S.C. 101, which establishes the Coast Guard, states the following: "The Coast Guard, established January 28, 1915, shall be a military service and a branch of the armed forces of the United States at all times."

Source: Table prepared by CRS, based on Coast Guard's FY2024 budget submission, HAC and SAC committee reports, and explanatory report on FY2024 DHS Appropriations Act.

Notes: HAC is House Appropriations Committee; **SAC** is Senate Appropriations Committee. S. 2625 as reported by SAC states, "That of the amounts made available [for the Coast Guard's Procurement, Construction, and Improvements account], $1,118,322,000 is designated by the Congress as being for an emergency requirement pursuant to section 251(b)(2)(A)(i) of the Balanced Budget and Emergency Deficit Control Act of 1985." In relation to the Balanced Budget and Emergency Deficit Control Act of 1985, S.Rept. 118-85 states: "Consistent with the funding recommended in the bill for disaster relief and for emergency requirements in accordance with subparagraphs (D) and (A)(i) of the Balanced Budget and Emergency Deficit Control Act of 1985, the Committee anticipates that the Budget Committee will provide, at the appropriate time, a 302(a) allocation for the Committee on Appropriations reflecting a net upward adjustment of $24,561,000,000 in budget authority plus the associated outlays." (Page 129, table note.)

Summary of Appropriation Action on FY2025 Funding Request

Table 4 summarizes congressional appropriation action on the Coast Guard's FY2025 procurement funding requests for icebreakers.

Table 4. Summary of Congressional Appropriations Action on FY2025 Procurement Funding Request

(In millions of dollars)

	Request	HAC	SAC	Final
Polar Security Cutter (PSC)	0			
Commercially available polar icebreaker (CAPI)	0[a]			
Great Lakes icebreaker (GLIB)	0[a]			

Source: Table prepared by CRS, based on Coast Guard's FY2025 budget submission, HAC and SAC committee reports, and conference report or explanatory report on FY2025 DHS Appropriations Act.

a. The Coast Guard's FY2025 Unfunded Priorities list (UPL) includes an item for $25.0 million in procurement funding for CAPI and another item for $25.0 million in procurement funding for GLIB.

FY2024 DHS Appropriations Act (H.R. 4367/S. 2625/Division C of H.R. 2882/P.L. 118-47)

House

The House Appropriations Committee, in its report (H.Rept. 118-123 of June 27, 2023) on H.R. 4367, recommends the funding levels shown in the HAC column of **Table 3**. The recommended reduction of $25.806 million for the PSC program is for long leadtime material (LLTM). (Page 48.) H.Rept. 118-123 states

> *Commercially Available Polar Icebreaker (CAPI).*—The recommendation provides the requested $125,000,000 for the CAPI program. The Committee feels strongly that the nation needs additional surface presence in the Arctic to protect economic and national security interests in the high latitudes, particularly given the ongoing delays with the PSC acquisition program….
>
> *Polar Security Cutter (PSC).*—The Committee provides $144,194,000 for the PSC program, a reduction of $25,806,000 below the request. The Committee recognizes the strategic importance of an expanded U.S. presence in the polar regions, especially in the Arctic. The Committee directs the Coast Guard to continue to provide additional program and schedule details, as described in the joint explanatory statement accompanying Public Law 117–103, as part of the required quarterly acquisition briefings. While the Committee is frustrated by the delays in the PSC program, the Committee is pleased with recent improvements in design maturity and continues strong support of the PSC program. Not

> later than 60 days after the date of enactment, the Coast Guard is directed to provide to the Committee a rebaselined schedule that fully accounts for the yearslong delays in the program. The Committee fully expects this rebaseline to include realistic projections of key milestones and delivery dates….
>
> *Great Lakes Icebreaker*.—The recommendation includes the requested funding of $55,000,000 for the analyze and select phase of the acquisition for a Great Lakes Icebreaker. Icebreaking capabilities are important to the economy of the Great Lakes region. The Committee notes that icebreaking technology has advanced since the acquisition of the CGC MACKINAW and urges the Coast Guard to consider innovative technologies and advances in ship design as the program management office works to complete the necessary pre-acquisition activities. This may include, but is not limited to, the use of ultra-high frequency sonic air cannon technology, drag-on bubblers, and environmentally safe anti-freezes in combination with a ship that features a low-drag hull shape. Additionally, the Committee suggests the Coast Guard consider the limitations in the CGC MACKINAW's maneuverability and whether such limitations adversely impact the vessel's capability. Further, in order for the Coast Guard to leverage the capacity of the nation's industrial base, including the Coast Guard's organic vessel repair capacity at the Coast Guard Yard, the Committee expects the vessel to be able to fully exit the Great Lakes. (Pages 48-49)

Senate

The Senate Appropriations Committee, in its report (S.Rept. of July 27, 2023) on S. 2625, recommends the funding levels shown in the SAC column of **Table 3**. S. 2625 as reported by the committee states (emphasis added):

> PROCUREMENT, CONSTRUCTION, AND IMPROVEMENTS
>
> For necessary expenses of the Coast Guard for procurement, construction, and improvements, including aids to navigation, shore facilities (including facilities at Department of Defense installations used by the Coast Guard), and vessels and aircraft, including equipment related thereto, $1,143,322,000, to remain available until September 30, 2028; of which $20,000,000 shall be derived from the Oil Spill Liability Trust Fund to carry out the purposes of section 1012(a)(5) of the Oil Pollution Act of 1990 (33 U.S.C. 2712(a)(5)): ***Provided,*** **That of the amounts made available under this heading, $1,118,322,000 is designated by the Congress as being for an emergency requirement pursuant to section 251(b)(2)(A)(i) of the Balanced Budget and Emergency Deficit Control Act of 1985.**

In relation to the above-mentioned Balanced Budget and Emergency Deficit Control Act of 1985, S.Rept. 118-85 states

> Consistent with the funding recommended in the bill for disaster relief and for emergency requirements in accordance with subparagraphs (D) and (A)(i) of the Balanced Budget and Emergency Deficit Control Act of 1985, the Committee anticipates that the Budget Committee will provide, at the appropriate time, a 302(a) allocation for the Committee on Appropriations reflecting a net upward adjustment of $24,561,000,000 in budget authority plus the associated outlays. (Page 129, table note)

S.Rept. 118-85 also states

> *Fleet Mix Analysis*.—The Committee continues to be interested in the Fleet Mix Analysis required in the Joint Explanatory Statement accompanying Public Law 117–103, and appreciates the Coast Guard's periodic status updates. The Committee reiterates its expectation, as stated in the requirement, that the analysis be truly comprehensive and include all classes of vessels, even those whose mission might not have a direct bearing on the workload of other vessel classes.

> *Full-Funding Policy*.—The Committee again directs an exception to the current acquisition policy that requires the Coast Guard to attain the total acquisition cost for a vessel, including long lead time materials [LLTM], production costs, and post-production costs, before a production contract can be awarded. This policy has the potential to make shipbuilding less efficient, to force delayed obligation of production funds, and to require post-production funds far in advance of when they will be used. The Department should position itself to acquire vessels in the most efficient manner within the guidelines of strict governance measures.
>
> *Funded Projects*.—The Committee expects that when it funds specific projects, those projects shall be executed expeditiously and responsibly. The Coast Guard shall be transparent with respect to cost increases, executability concerns, and any other issues that may increase the risk profile of a project, and shall provide the Committee sufficient time to consider the issue and respond in an appropriate manner….
>
> *Polar Security Cutter [PSC]*.—No funding is provided to the PSC program. The Committee remains concerned with the progress of the PSC program, but is hopeful that the Coast Guard will show progress towards a design and a plan for future construction. Within 90 days of the date of enactment of this act, the Coast Guard shall brief the Committee on the program's progress, and shall provide a timeline for the completion of a detailed design and the construction of PSC 1.
>
> *Great Lakes Icebreaker [GLIB]*.—The Committee provides $55,000,000, as requested, for the procurement of a new GLIB that is at least as capable as the USCG MACKINAW.
>
> *Commercially Available Polar Icebreaker*.—The Committee provides $125,000,000 for the acquisition of a commercially available polar icebreaker, as requested. (Pages 75-76)

Enacted

The explanatory report for Division C of H.R. 2882/P.L. 118-47 of March 23, 2024, provides the funding levels shown in the "Enacted" column of **Table 3**. The explanatory statement states:

> *Polar Security Cutter (PSC).*—The Coast Guard is directed to keep the Committees fully informed of the PSC program's progress both with regular quarterly updates and, in the case of emergent or time sensitive issues, as soon as possible.
>
> In addition, within 120 days of the date of enactment of this Act, the Coast Guard is directed to provide a report that assesses the viability of reactivating Coast Guard Cutter Polar Sea. The report shall include an analysis of the material condition of the hull and cost and timeline estimates for a full overhaul of the vessel, including the renewal of the cutter's propulsion, mechanical, electrical, communication, and support systems. (PDF page 31 of 125)

Appendix A. Current U.S. Polar Icebreakers and Polar Research Ships

This appendix provides background information on current U.S. polar icebreakers and polar research ships.

Three Coast Guard Polar Icebreakers

Two Heavy Polar Icebreakers—*Polar Star* and *Polar Sea*

Polar Star (WAGB-10) and *Polar Sea* (WAGB-11),[82] sister ships built to the same general design (**Figure A-1** and **Figure A-2**), were acquired in the early 1970s as replacements for earlier U.S. icebreakers. They were designed for 30-year service lives, and were built by Lockheed Shipbuilding of Seattle, WA, a division of Lockheed that also built ships for the U.S. Navy, but which exited the shipbuilding business in the late 1980s.

Figure A-1. *Polar Star* and *Polar Sea*

(Side by side in McMurdo Sound, Antarctica)

Source: Coast Guard photograph that was accessed on April 21, 2011, at http://www.uscg.mil/pacarea/cgcpolarsea/history.asp (link no longer active). The photograph accompanies Kyung M. Song, "Senate Passes Cantwell Measure to Postpone Scrapping of Polar Sea Icebreaker," *Seattle Times*, September 22, 2012, posted at http://blogs.seattletimes.com/politicsnorthwest/2012/09/22/senate-passes-cantwell-measure-to-postpone-scrapping-of-polar-sea-icebreaker/.

[82] The designation WAGB means Coast Guard icebreaker. More specifically, W means Coast Guard ship, A means auxiliary, G means miscellaneous purpose, and B means icebreaker.

Figure A-2. *Polar Sea*

Source: Coast Guard photograph that was accessed April 21, 2011, at http://www.uscg.mil/pacarea/cgcpolarsea/img/PSEApics/FullShip2.jpg (link no longer active). The photograph accompanies Associated Press, "Reprieve for Seattle-Based Icebreaker Polar Sea," KOMO News, June 15, 2012, posted at https://komonews.com/news/local/reprieve-for-seattle-based-icebreaker-polar-sea.

The ships are 399 feet long and displace about 13,200 tons.[83] They are among the world's most powerful nonnuclear-powered icebreakers, with a capability to break through ice up to 6 feet thick at a speed of 3 knots. Because of their icebreaking capability, they are considered (in U.S. parlance) heavy polar icebreakers. In addition to a crew of 134, each ship can embark a scientific research staff of 32 people.

Polar Star was commissioned into service on January 19, 1976, and consequently is now more than 10 years beyond its originally intended 30-year service life. Due to worn-out electric motors and other problems, the Coast Guard placed the ship in caretaker status on July 1, 2006.[84] Congress in FY2009 and FY2010 provided funding to repair *Polar Star* and return it to service for 7 to 10 years; the repair work, which reportedly cost about $57 million, was completed, and the ship was reactivated on December 14, 2012.[85]

Polar Sea was commissioned into service on February 23, 1978, and consequently is also more than 10 years beyond its originally intended 30-year service life. In 2006, the Coast Guard completed a rehabilitation project that extended the ship's expected service life to 2014. On June 25, 2010, however, the Coast Guard announced that *Polar Sea* had suffered an engine casualty, and the ship was unavailable for operation after that.[86] The Coast Guard placed *Polar Sea* in

[83] By comparison, the Coast Guard's new National Security Cutters—its new high-endurance cutters—are about 418 feet long and displace roughly 4,000 tons.

[84] Source for July 1, 2006, date: U.S. Coast Guard email to CRS on February 22, 2008. The Coast Guard's official term for caretaker status is "In Commission, Special."

[85] See, for example, Kyung M. Song, "Icebreaker Polar Star Gets $57 Million Overhaul," *Seattle Times*, December 14, 2012.

[86] "Icebreaker POLAR SEA Sidelined By Engine Troubles," *Coast Guard Compass (Official Blog of the U.S. Coast Guard)*, June 25, 2010. See also "USCG Cancels Polar Icebreaker's Fall Deployment," *DefenseNews.com*, June 25, 2010; Andrew C. Revkin, "America's Heavy Icebreakers Are Both Broken Down," *Dot Earth (New York Times blog)*, June 25, 2010.

commissioned, inactive status on October 14, 2011. The Coast Guard transferred certain major equipment from *Polar Sea* to *Polar Star* to facilitate *Polar Star*'s return to service.[87]

Although the Coast Guard in recent years has invested millions of dollars to overhaul, repair, and extend the service life of *Polar Star*, the ship's material condition, as a result of its advancing age, has nevertheless become increasingly fragile, if not precarious. During its annual deployments to McMurdo Station in Antarctica, shipboard equipment frequently breaks, and shipboard fires sometimes occur.[88] Replacements for many of the ship's components are no longer commercially available. To help keep *Polar Star* operational, the Coast Guard continues to use *Polar Sea* as a source of replacement parts.

One Medium Polar Icebreaker—*Healy*

Healy (WAGB-20) (**Figure A-3**) was funded in the early 1990s as a complement to *Polar Star* and *Polar Sea*, and was commissioned into service on August 21, 2000.

Figure A-3. *Healy*

Source: Coast Guard photograph accessed August 12, 2019, at https://www.history.uscg.mil/US-Coast-Guard-Photo-Gallery/igphoto/2002136680/.

[87] Source: October 17, 2011, email to CRS from Coast Guard Congressional Affairs office. Section 222 of the Coast Guard and Maritime Transportation Act of 2012 (H.R. 2838/P.L. 112-213 of December 20, 2012) prohibited the Coast Guard from removing any part of Polar Sea and from transferring, relinquishing ownership of, dismantling, or recycling the ship until it submitted a business case analysis of the options for and costs of reactivating the ship and extending its service life to at least September 30, 2022, so as to maintain U.S. polar icebreaking capabilities and fulfill the Coast Guard's high latitude mission needs, as identified in the Coast Guard's July 2010 High Latitude Study. The business case analysis was submitted to Congress with a cover date of November 7, 2013. For more on the High Latitude Study, see **Appendix B**.

[88] See, for example, Richard Read, "Meet the Neglected 43-Year-Old Stepchild of the U.S. Military-Industrial Complex," *Los Angeles Times*, August 2, 2019; Melody Schreiber, "The Only Working US Heavy Icebreaker Catches Fire Returning from Antarctica," *Arctic Today*, March 2, 2019; Calvin Biesecker, "Fire Breaks Out On Coast Guard's Aging, and Only, Heavy Icebreaker," *Defense Daily*, March 1, 2019.

The ship was built by Avondale Industries, a shipyard located near New Orleans, LA, that built numerous Coast Guard and Navy ships, and which eventually became part of Huntington Ingalls Industries (HII). (HII subsequently wound down shipbuilding activities at Avondale, and the facility is no longer building ships.)

Although it is referred to (in U.S. parlance) as a medium polar icebreaker, *Healy* is actually larger than *Polar Star* and *Polar Sea*—it is 420 feet long and displaces about 16,000 tons. Compared to *Polar Star* and *Polar Sea*, *Healy* has less icebreaking capability (which is why it is referred to as a medium polar icebreaker rather than a heavy polar icebreaker), but more capability for supporting scientific research. The ship can break through ice up to 4½ feet thick at a speed of 3 knots, and embark a scientific research staff of 35 (with room for another 15 surge personnel and 2 visitors). The ship is used primarily for supporting scientific research and conducting other operations in the Arctic.

Three National Science Foundation (NSF) Polar Research Ships

Nathaniel B. Palmer

Nathaniel B. Palmer (**Figure A-4**) was built for the NSF in 1992 by North American Shipbuilding, of Larose, LA.

Figure A-4. *Nathaniel B. Palmer*

Source: Photograph accompanying Peter Rejcek, "System Study, LARISSA Takes Unique Approach for Research on Ice Shelf Ecosystem," *Antarctic Sun* (Untied States Antarctic Program), September 18, 2009. A caption to the photograph states "Photo Courtesy: Adam Jenkins."

Called *Palmer* for short, it is operated for NSF by Edison Chouest Offshore (ECO) of Galliano, LA, a firm that owns and operates research ships and offshore deepwater service ships.[89] *Palmer* is 308 feet long and has a displacement of about 6,500 tons. It has a crew of 22 and can embark a

[89] For more on ECO, see the firm's website at http://www.chouest.com/.

scientific staff of 27 to 37.[90] It was purpose-built as a single-mission ship for conducting and supporting scientific research in the Antarctic. It is capable of breaking ice up to 3 feet thick at speeds of 3 knots, which is sufficient for breaking through the ice conditions found in the vicinity of the Antarctic Peninsula, so as to resupply Palmer Station, a U.S. research station on the peninsula. The ship might be considered less an icebreaker than an oceanographic research ship with enough icebreaking capability for the Antarctic Peninsula. *Palmer's* icebreaking capability is not considered sufficient to perform the McMurdo resupply mission.

Laurence M. Gould

Like *Palmer*, the polar research and supply ship *Laurence M. Gould* (**Figure A-5**) was built for NSF by North American Shipping. It was completed in 1997 and is operated for NSF on a long-term charter from ECO. It is 230 feet long and has a displacement of about 3,800 tons. It has a crew of 16 and can embark a scientific staff of 26 to 28 (with a capacity for 9 more in a berthing van). It can break ice up to 1 foot thick with continuous forward motion. Like *Palmer*, it was built to support NSF operations in the Antarctic, particularly operations at Palmer Station on the Antarctic Peninsula.

Figure A-5. *Laurence M. Gould*

Source: Photograph accompanying Alchetron, "RV Laurence M. Gould," updated August 25, 2018, accessed August 7, 2019, at https://alchetron.com/RV-Laurence-M.-Gould#-.

[90] Sources vary on the exact number of scientific staff that can be embarked on the ship. For some basic information on the ship, see http://www.nsf.gov/od/opp/support/nathpalm.jsp;
http://www.usap.gov/vesselScienceAndOperations/documents/prvnews_june03.pdfprvnews_june03.pdf;
http://nsf.gov/od/opp/antarct/treaty/pdf/plans0607/15plan07.pdf;
http://www.nsf.gov/pubs/1996/nsf9693/fls.htm; and
http://www.hazegray.org/worldnav/usa/nsf.htm.

Sikuliaq

Sikuliaq (see-KOO-lee-auk; **Figure A-6**), which is used for scientific research in polar areas, was built by Marinette Marine of Marinette, WI, and entered service in 2015. It is operated for NSF by the College of Fisheries and Ocean Sciences at the University of Alaska Fairbanks as part of the U.S. academic research fleet through the University National Oceanographic Laboratory System (UNOLS). *Sikuliaq* is 261 feet long and has a displacement of about 3,600 tons. It has a crew of 22 and can embark an additional 26 scientists and students. The ship can break ice 2½ or 3 feet thick at speeds of 2 knots. The ship is considered less an icebreaker than an ice-capable research ship.

Figure A-6. *Sikuliaq*

Source: Photograph accompanying Lauren Frisch, "UAF Joins International Consortium of Icebreaker Operators," *UAF [University of Alaska Fairbanks] News and Information*, February 6, 2018. A caption to the photograph states in part: "Photo by Mark Teckenbrock. The research vessel Sikuliaq navigates through Arctic ice in summer 2016."

Summary of Above Ships

Table A-1 summarizes the above six ships.

Table A-1. Coast Guard and NSF Polar Ships

	Coast Guard			NSF		
	Polar Star	***Polar Sea***	***Healy***	***Palmer***	***Laurence M. Gould***	***Sikuliaq***
Currently operational?	Yes	No	Yes	Yes	Yes	Yes
Entered service	1976	1978	2000	1992	1997	2015
Length (feet)	399	399	420	308	230	261
Displacement (tons)	13,200	13,200	16,000	6,500	3,780	3,665
Icebreaking capability (ice thickness in feet) at 3 knots or other speed	6 feet	6 feet	4.5 feet	3 feet	1 foot at continuous forward motion	2.5 or 3 feet at 2 knots
Icebreaking capability using back and ram (ice thickness in feet)	21 feet	21 feet	8 feet	n/a	n/a	n/a
Operating temperature	-60° Fahrenheit	-60° Fahrenheit	-50° Fahrenheit	n/a	n/a	n/a
Crew (when operational)	155[a]	155[a]	85[b]	22	16	22
Additional scientific staff	32	32	35[c]	27-37	26 to 28[d]	26

Sources: Prepared by CRS using data from U.S. Coast Guard, National Research Council, National Science Foundation, DHS Office of Inspector General, and (for *Palmer*) additional online reference sources.

Notes: n/a is not available.

a. Includes 24 officers, 20 chief petty officers, 102 enlisted, and 9 in the aviation detachment.

b. Includes 19 officers, 12 chief petty officers, and 54 enlisted.

c. In addition to 85 crew members 85 and 35 scientists, the ship can accommodate another 15 surge personnel and 2 visitors.

d. Plus 9 more in a berthing van.

Commercial Ship *Aiviq*

In addition to the ships shown in **Table A-1**, another U.S.-registered polar ship with icebreaking capability—the 360-foot Arctic oil-exploration support ship *Aiviq* (**Figure A-7** and **Figure A-8**)—was used by Royal Dutch Shell oil company to support an oil exploration and drilling effort (now ended) in Arctic waters off Alaska. The ship, which completed construction in 2012, is owned by ECO. It was used primarily for towing and laying anchors for drilling rigs, but is also equipped for responding to oil spills.

As of 2022, the ship was listed as being offered for purchase.[91] As noted earlier in this report, an April 28, 2022, press report states that *Aiviq* is the "most likely candidate" for the Coast Guard's proposal in its FY2024 budget submission to purchase an existing commercially available polar icebreaker that would be used to augment the Coast Guard's polar icebreaking capacity until the new PSCs enter service.

The Australian Antarctic Program states that "The Australian Antarctic Division first chartered the *Aiviq* for the 2021/22 season. The Aiviq undertook two voyages south, refuelling Davis and Mawson and assisting with resupply and changeover of expeditioner teams.... The *Aiviq* will form

[91] See "360' DP2 Icebreaker AHTS Multi Purpose Accommodations 2012 – BHP 21776," Horizon Ship Brokers, undated, accessed April 29, 2022, at https://horizonship.com/ship/360-dp2-icebreaker-ahts-multi-purpose-accommodations-2012-bhp-21776/.

a large part of the 2022/23 shipping season, with RSV *Nuyina's* return from maintenance delayed due to a delay in receiving spare parts.[92] (*Nuyina* is an Australian Antarctic icebreaker.)

Figure A-7. Commercial Ship *Aiviq*

Source: "AIVIQ - IMO 9579016," Shipspotting.com, undated, accessed April 29, 2022, at https://www.shipspotting.com/photos/1523039. The photograph, dated March 24, 2012, is credited to PJBlackbird.

[92] "MPOV Aiviq 2021-Present," Australian Antarctic Program, updated September 16, 2022, accessed March 30, 2023, at https://www.antarctica.gov.au/about-antarctica/history/transportation/shipping/mpov-aiviq/.

Figure A-8. Commercial Ship *Aiviq*

Source: Cropped version of photograph accompanying "*Aiviq*," Wikipedia, accessed April 29, 2022, which states that the photograph is dated December 30, 2012, and credits the photograph to U.S. Coast Guard Petty Officer 3rd Class Chris Usher.

Appendix B. Required Numbers of U.S. Polar Icebreakers

This appendix provides additional background information on required numbers of U.S. polar icebreakers.

June 9, 2020, Presidential Memorandum

On June 9, 2020, President Trump issued a memorandum, "Memorandum on Safeguarding U.S. National Interests in the Arctic and Antarctic Regions," which states

> Memorandum for the Secretary of State, the Secretary of Defense, the Secretary of Commerce, the Secretary of Energy, the Secretary of Homeland Security, the Director of the Office of Management and Budget, [and] the Assistant to the President for National Security Affairs
>
> Subject: Safeguarding U.S. National Interests in the Arctic and Antarctic Regions
>
> To help protect our national interests in the Arctic and Antarctic regions, and to retain a strong Arctic security presence alongside our allies and partners, the United States requires a ready, capable, and available fleet of polar security icebreakers that is operationally tested and fully deployable by Fiscal Year 2029. Accordingly, by the authority vested in me as President by the Constitution and the laws of the United States of America, I hereby direct the following:
>
> Section 1. Fleet Acquisition Program. The United States will develop and execute a polar security icebreaking fleet acquisition program that supports our national interests in the Arctic and Antarctic regions.
>
> (a) The Secretary of Homeland Security, in coordination with the Secretary of State, the Secretary of Defense, the Secretary of Commerce, and the Director of the Office of Management and Budget (OMB), shall lead a review of requirements for a polar security icebreaking fleet acquisition program to acquire and employ a suitable fleet of polar security icebreakers, and associated assets and resources, capable of ensuring a persistent United States presence in the Arctic and Antarctic regions in support of national interests and in furtherance of the National Security Strategy and the National Defense Strategy, as appropriate. Separately, the review shall include the ability to provide a persistent United States presence in the Antarctic region, as appropriate, in accordance with the Antarctic Treaty System. The Secretary of Homeland Security and the Director of OMB, in executing this direction, shall ensure that the United States Coast Guard's (USCG) Offshore Patrol Cutter acquisition program is not adversely impacted.
>
> (b) The Secretary of Homeland Security, acting through the Commandant of the Coast Guard, in coordination with the Secretary of Defense, acting through the Secretary of the Navy, and the Secretary of Energy, as appropriate, shall conduct a study of the comparative operational and fiscal benefits and risks of a polar security icebreaking fleet mix that consists of at least three heavy polar-class security cutters (PSC) that are appropriately outfitted to meet the objectives of this memorandum. This study shall be submitted to the President, through the Director of OMB and the Assistant to the President for National Security Affairs, within 60 days from the date of this memorandum and at a minimum shall include:
>
> (i) Use cases in the Arctic that span the full range of national and economic security missions (including the facilitation of resource exploration and exploitation and undersea cable laying and maintenance) that may be executed by a class of medium PSCs, as well as analysis of how these use cases differ with respect to the anticipated use of heavy PSCs

for these same activities. These use cases shall identify the optimal number and type of polar security icebreakers for ensuring a persistent presence in both the Arctic and, as appropriate, the Antarctic regions;

(ii) An assessment of expanded operational capabilities, with estimated associated costs, for both heavy and medium PSCs not yet contracted for, specifically including the maximum use of any such PSC with respect to its ability to support national security objectives through the use of the following: unmanned aviation, surface, and undersea systems; space systems; sensors and other systems to achieve and maintain maritime domain awareness; command and control systems; secure communications and data transfer systems; and intelligence-collection systems. This assessment shall also evaluate defensive armament adequate to defend against threats by near-peer competitors and the potential for nuclear-powered propulsion;

(iii) Based on the determined fleet size and composition, an identification and assessment of at least two optimal United States basing locations and at least two international basing locations. The basing location assessment shall include the costs, benefits, risks, and challenges related to infrastructure, crewing, and logistics and maintenance support for PSCs at these locations. In addition, this assessment shall account for potential burden-sharing opportunities for basing with the Department of Defense and allies and partners, as appropriate; and

(iv) In anticipation of the USCGC POLAR STAR's operational degradation from Fiscal Years 2022-2029, an analysis to identify executable options, with associated costs, to bridge the gap of available vessels as early as Fiscal Year 2022 until the new PSCs required to meet the objectives of this memorandum are operational, including identifying executable, priced leasing options, both foreign and domestic. This analysis shall specifically include operational risk associated with using a leased vessel as compared to a purchased vessel to conduct specified missions set forth in this memorandum.

(c) In the interest of securing a fully capable polar security icebreaking fleet that is capable of providing a persistent presence in the Arctic and Antarctic regions at the lowest possible cost, the Secretary of State shall coordinate with the Secretary of Homeland Security in identifying viable polar security icebreaker leasing options, provided by partner nations, as a near- to mid-term (Fiscal Years 2022-2029) bridging strategy to mitigate future operational degradation of the USCGC POLAR STAR. Leasing options shall contemplate capabilities that allow for access to the Arctic and Antarctic regions to, as appropriate, conduct national and economic security missions, in addition to marine scientific research in the Arctic, and conduct research in Antarctica in accordance with the Antarctic Treaty System. Further, and in advance of any bid solicitation for future polar security icebreaker acquisitions, the Secretary of State shall coordinate with the Secretary of Homeland Security to identify partner nations with proven foreign shipbuilding capability and expertise in icebreaker construction.

(d) The Secretary of Defense shall coordinate with the Secretary of State and the Secretary of Homeland Security to continue to provide technical and programmatic support to the USCG integrated program office for the acquisition, outfitting, and operations of all classes of PSCs.

Sec. 2. General Provisions. (a) Nothing in this memorandum shall be construed to impair or otherwise affect:

(i) the authority granted by law to an executive department or agency, or the head thereof; or

(ii) the functions of the Director of OMB relating to budgetary, administrative, or legislative proposals.

> (b) This memorandum shall be implemented consistent with applicable law and subject to the availability of appropriations.
>
> (c) This memorandum is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.[93]

A September 10, 2020, press report states

> The White House dropped a surprise directive in June calling for a new strategy in the High North, a move applauded by Arctic watchers who've been waiting for an administration to make the issue a priority….
>
> Yet a month after the report was due to the White House, it's not clear when, or if, anyone will see it.
>
> The report, which was to include new designs for a fleet of possibly nuclear-powered icebreakers, has been submitted to the National Security Council. Yet an NSC spokesperson did not respond to a query on the timing of a release, and would only say the report is "under review."[94]

A December 3, 2020, press report states

> The Coast Guard and its partners are assessing options for additional polar icebreaking capacity in the next decade beyond current plans pursuant to a directive from the Trump administration, Coast Guard Commandant Adm. Karl Schultz said on Thursday [December 3].
>
> The Coast Guard's current polar strategy calls for six new icebreakers, at least three of them heavy, and one immediately, and now "The good news is there's been a conversation beyond the 6-3-1 strategy," Schultz said during a virtual address hosted by the Navy League. "The president and his team have pressed us here since this past summer pulling together the energy of five cabinet level officials and OMB [Office of management and Budget] about saying, 'Hey, what does more capacity for high-latitude work between now and 2029 look like?'"…
>
> The Coast Guard hasn't looked favorably in the past on leasing options for ice breakers, at least not as a permanent solution to its polar requirements. But Schultz said leasing could fill near-term gaps.
>
> "We clearly don't want to be looking at leasing options as a replacement for the procurement of ships that are going to serve us for decades to come, but there might be some bridging strategies and some leasing options," he said. "So, we're working really hard on that, answering some deliverables over to the White House and hope we can keep some momentum."
>
> A Coast Guard spokesman told Defense Daily following Schultz's speech that the service and the Navy "have formed a joint working group to assess available foreign and domestic vessels that would meet short-term mission needs in the Arctic. The Coast Guard is continuing to evaluate all options and provide detailed analysis of icebreaker capacity,

[93] White House, "Memorandum on Safeguarding U.S. National Interests in the Arctic and Antarctic Regions," June 9, 2020, accessed June 10, 2020, at https://www.whitehouse.gov/presidential-actions/memorandum-safeguarding-u-s-national-interests-arctic-antarctic-regions/. For press reports about the memorandum, see, for example, David B. Larter, Joe Gould, and Aaron Mehta, "Trump Memo Demands New Fleet of Arctic Icebreakers Be Ready by 2029," *Defense News*, June 9, 2020; Paul McLeary, "White House Orders New Icebreaker Strategy For Coast Guard," *Breaking Defense*, June 9, 2020; Cal Biesecker, "Trump Wants Review Of Polar Security Cutter Needs In Arctic, Antarctic," *Defense Daily*, June 9, 2020.

[94] Sarah Cammarata, "Trump's Arctic Plan Stuck in the Ice," *Politico Pro*, September 10, 2020.

lease options, and long-term strategies to protect vital economic and national security interests in the Polar Regions."[95]

A December 16, 2020, press report stated

> The White House National Security Adviser and the Navy may be on the verge of agreeing to move forward shortly with a plan to lease medium polar icebreakers to fill a near-term gap in the Coast Guard's icebreaking needs, Alaska Sen. Dan Sullivan (R) said last week.
>
> Sullivan, during a Dec. 8 hearing that he chaired that morning on the Coast Guard's capabilities in the Arctic, said he spoke earlier that day with White House National Security Adviser Robert O'Brien, who told him that the U.S. is looking at leasing polar icebreakers from Finland.
>
> "My understanding is the White House National Security Adviser [and] possibly the Navy with regard to some of their funding, are looking at moving forward on leases soon, hopefully as early as the end of this month," Sullivan told Adm. Charles Ray, vice commandant of the Coast Guard.
>
> Ray replied that discussions on leasing are part of a presidential directive issued in June, noting that a joint Coast Guard and Navy group are looking into this.
>
> Later during the hearing, in response to a question from Sen. Mike Lee (R-Utah) about potentially buying polar icebreakers from NATO allies or friendly Arctic nations, Ray said the "The bridging strategy that makes the most sense to the Coast Guard at this point is this potential to lease one of these icebreakers."
>
> Ray pointed out to Sullivan that the potential leasing strategy is not in place of the Coast Guard eventually acquiring new polar icebreakers.
>
> A Coast Guard spokesman on Wednesday told Defense Daily that the exact number if icebreakers that would be leased hasn't been determined and "depends on individual vessel availability and capabilities, crew availability, funding, and other factors." He also said the options only included medium icebreakers because no heavy icebreakers are currently available that meet the service's minimum requirements.…
>
> The Coast Guard spokesman said a bridging strategy is being examined because the first PSC won't begin operations until 2027. Any leased vessels, which potentially could be domestic or foreign flagged, would operate in the Arctic "to project U.S. sovereignty; protect vital economic and national security interests; and conduct maritime domain awareness, search and rescue, and other Coast Guard missions," he wrote in an email response to questions.…
>
> Ray said that a key shortfall of leasing commercial polar icebreakers is they aren't built to military specifications, highlighting communications, damage control and compartmentalization in case of an incident.
>
> "They're a different cat," Ray said. "We would have to do some work to them. It's not just, take one off the shelf. If it was, we probably would have done that a long time ago. So, there will be some work required to make these for the Coast Guard. But with that said, it is the commandant's position and our position we will certainly consider this and work to see what makes sense to bridge this gap."[96]

[95] Cal Biesecker, "Coast Guard, Partners Assessing Options For More Polar Icebreaking Capacity," *Defense Daily*, December 3, 2020.

[96] Cal Biesecker, "Senator Says Decision Could Come Soon to Lease Icebreakers for Coast Guard," *Defense Daily*, December 16, 2020. See also Liz Ruskin, "Trump Administration May Hire Private Ship to Fill Arctic 'Icebreaker Gap' by Year's End," *Alaska Public Radio*, December 14, 2020.

June 2013 DHS Polar Icebreaker Mission Need Statement

DHS in June 2013 approved a Mission Need Statement (MNS) for the polar icebreaker recapitalization project. The MNS states the following (emphasis added):

> This Mission Need Statement (MNS) establishes the need for polar icebreaker capabilities provided by the Coast Guard, to ensure that it can meet current and future mission requirements in the polar regions....
>
> Current requirements and future projections based upon cutter demand modeling, as detailed in the HLMAR [High Latitude Mission Analysis Report], indicate **the Coast Guard will need to expand its icebreaking capacity, potentially requiring a fleet of up to six icebreakers (3 heavy and 3 medium) to adequately meet mission demands in the high latitudes**.... The analysis took into account both the Coast Guard statutory mission requirements and additional requirements for year-round presence in both polar regions detailed in the Naval Operations Concept (NOC) 2010.... The analysis also evaluated employing single and multi-crewing concepts.... Strategic home porting analysis based upon existing infrastructure and distance to operational areas provided the final input to determine icebreaker capacity demand.[97]

While the MNS can be viewed as an authoritative U.S. government statement regarding required numbers of U.S. polar icebreakers, it can be noted that the key sentence in the above-quoted passage from the MNS (i.e., the sentence in bold) includes the terms "potentially" and "up to." These terms, which are often overlooked in discussions of required numbers of U.S. polar icebreakers, make the key sentence less ironclad as a requirements statement than it would have been if the terms had not been included, and could be interpreted as an acknowledgment that the requirement might amount to something less than three heavy and three medium polar icebreakers.

It can also be noted, as stated in the above-quoted passage from the MNS, that the MNS was informed by the High Latitude Mission Analysis Report (HILMAR), and that the HLMAR took into account not only Coast Guard statutory mission requirements, but additional DOD requirements for year-round presence in both polar regions as detailed in the 2010 Naval Operations Concept (NOC). This is potentially significant, because DOD appears to have subsequently dropped its 2010 requirement for year-round presence in the polar regions.[98]

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[97] Department of Homeland Security, *Polar Icebreaking Recapitalization Project Mission Need Statement, Version 1.0*, approved by DHS June 28, 2013, pp. 1, 2, 9, 10, 11, 12.

[98] A September 25, 2017, GAO report on polar icebreakers states the following (emphasis added):

> In December 2016, DOD reported to Congress that it had no specific defense requirement for icebreaking capability because Navy Arctic requirements are met by undersea and air assets which can provide year-round presence.
>
> —DOD reported in April 2017 that its only potential defense requirement—for the Thule Air Force Base resupply [mission] in Greenland—is met by the Canadian Coast Guard through a Memorandum of Understanding with USCG.
>
> —USCG's 2013 Polar Icebreaker Mission Needs Statement identified polar icebreaker capacity needs as partly based on the 2010 Naval Operations Concept—[a document that provides] joint maritime security strategy implementation guidance for the Navy, Marine Corps, and USCG—which stated that U.S. naval forces had a demand for year-round polar icebreaking presence in the Arctic and Antarctic.
>
> —In April 2017, DOD joint staff officials confirmed that DOD and Naval defense strategy had been updated and does not include icebreaking requirements. DOD officials in charge of operations in the Pacific said that although they do not have a requirement for a heavy icebreaker, icebreakers play a key role in aiding the icebreaking mission to McMurdo.

(continued...)

The use in the MNS of the terms "potentially" and "up to," combined with DOD's decision to drop its requirement for year-round presence in the polar regions, together raise a question, other things held equal, as to whether required numbers of U.S. polar icebreakers might be something less than three heavy and three medium polar icebreakers. It is also possible, however, that there have been other changes since the MNS was issued in 2013 that would have the effect, other things held equal, of *increasing* U.S. requirements for polar icebreakers. The net result of this situation appears uncertain.

In recent years, Coast Guard officials have tended to refer simply to a total Coast Guard requirement for three heavy and three medium polar icebreakers. For example, in the October 25, 2016, summary of a request for information (RFI) that the Coast Guard released the next day to receive industry feedback on its notional polar icebreaker acquisition approach and schedule, the Coast Guard states that "the United States Coast Guard has a need for three Heavy Polar Icebreakers and three Medium Polar Icebreakers with the priority being Heavy Polar Icebreakers."[99] A requirement for three heavy and three medium polar icebreakers is often abbreviated as 3+3.

Short of a 3+3 requirement, Coast Guard officials in the past have sometimes stated that, as a bare minimum number of heavy polar icebreakers, the Coast Guard needs two such ships. For example, at a November 17, 2015, hearing before the Europe, Eurasia, and Emerging Threats subcommittee and the Western Hemisphere subcommittee of the House Foreign Affairs Committee, then-Vice Admiral Charles Michel, the Vice Commandant of the Coast Guard, stated during the discussion portion of the hearing that the "Coast Guard needs at least two heavy icebreakers to provide year-round assured access and self-rescueability in the polar regions."[100] Similarly, at a June 14, 2016, hearing before the Coast Guard and Maritime Transportation subcommittee of the House Transportation and Infrastructure Committee, Admiral Michel testified that "our commandant also testified that we need self-rescue capability for our heavy icebreaker and that includes the existing *Polar Star* that we have out there now. So that means at least two [ships], [and] the High Latitude study says three heavy polar icebreakers is what the Coast Guard's requirement is. So that's kind of where we're talking about for heavy icebreakers."[101]

A September 25, 2017, GAO report on polar icebreakers states that

> the Coast Guard has been unable to address all polar icebreaking requests since 2010. For example, the Coast Guard reported fulfilling 78 percent (25 of 32) of U.S. government agency requests for polar icebreaking services during fiscal year 2010 through 2016. Coast Guard officials cited various factors affecting the Coast Guard's ability to meet all requests, particularly the unavailability of its heavy polar icebreakers.[102]

A July 2018 GAO report stated that

> the Coast Guard operates one medium icebreaker, the Healy, which has an expected end of service life in 2029. Despite the requirement for three medium icebreakers, Coast Guard officials said they are not currently assessing acquisition of the medium polar icebreakers

> (Government Accountability Office, *Coast Guard: Status of Polar Icebreaking Fleet Capability and Recapitalization Plan*, GAO-17-698R, September 25, 2017, p. 20 (briefing slide 11).)

[99] Summary of RFI, October 25, 2016, page 2, accessed November 10, 2016, at https://www.uscg.mil/acquisition/icebreaker/pdf/Acquisition-Strategy-RFI.pdf.

[100] Transcript of hearing.

[101] Transcript of hearing.

[102] Government Accountability Office, *Coast Guard: Status of Polar Icebreaking Fleet Capability and Recapitalization Plan*, GAO-17-698R, September 25, 2017, pp. 2-3. A similar statement appears on page 4.

> because they are focusing on the heavy icebreaker acquisition and plan to assess the costs and benefits of acquiring medium polar icebreakers at a later time.[103]

In addition to the HILMAR, a number of other studies have been conducted in recent years to assess U.S. requirements for polar icebreakers and options for sustaining and modernizing the Coast Guard's polar icebreaker fleet.

Polar Icebreakers Operated by Other Countries

In discussions of U.S. polar icebreakers, observers sometimes note the sizes of polar icebreaking fleets operated by other countries. **Table B-1** shows a Coast Guard summary of major polar icebreakers around the world.

Some observers highlight the difference between the number of U.S. polar icebreakers and the much larger number of Russian polar icebreakers, and characterize the situation as an "icebreaker gap."[104] Other observers question the relevance of that comparison and characterization.[105] In considering the number of Russian polar icebreakers, factors that may be considered include the length of Russia's Arctic coastline and Russia's use of maritime transportation along its Arctic coastline to support numerous Russian Arctic communities. (Russia's Arctic population is roughly 2 million.[106]) Countries with interests in the polar regions have differing requirements for polar icebreakers, depending on the nature and extent of their polar interests and activities. (The term *icebreaker gap* is also sometimes used to refer to a potential gap in time between the end of *Polar Star's* service life and the entry into service of the first PSC, or to discuss options, such as leasing existing icebreakers, for bolstering U.S. polar icebreaking capability prior to the entry into service of the first PSC.[107])

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[103] Government Accountability Office, *Coast Guard Acquisitions[:] Actions Needed to Address Longstanding Portfolio Management Challenges*, GAO-18-454, July 2018, p. 13.

[104] See, for example, Mike Glenn, "U.S. Icebreaker Gap with Russia a Growing Concern as Arctic 'Cold War' Heats Up," *Washington Times*, September 23, 2021; Lin A. Mortensgaard and Kristian Søby Kristensen, "The 'Icebreaker-Gap'—How US Icebreakers Are Assigned New, Symbolic Roles as Part of an Escalating Military Competition in the Arctic," Safe Seas, January 5, 2021; Christopher Woody, "As US Tries to Close 'Icebreaker Gap' with Russia, Its Only Working Icebreaker Is Making a Rare Trip North," *Business Insider*, November 9, 2020; Peter Kikkert, *Gaps and Bridges: The Case for American Polar Icebreakers*, North American Arctic Defence and Security Network, August 12, 2020, 5 pp.; Marc Lanteigne, "So What Is the 'Icebreaker Gap' Anyway?" *Over the Circle*, March 3, 2019; Charlie Gao, "The 'Icebreaker Gap': How Russia is Planning to Build more Icebreakers to Project Power in the Arctic," *National Interest*, August 19, 2018; Dermot Cole, "The US Is Finally Picking Up the Pace to Build a Modern Heavy Icebreaker," *ArcticToday*, April 21, 2018; Craig H. Allen Sr., "Addressing the US Icebreaker Shortage," *Pacific Maritime*, December 2017: 30-33; Adam Lemon and Brian Slattery, "Standoff in The Arctic: Closing the Icebreaker Gap," *Newsweek*, August 14, 2016; Franz-Stefan Gady, "Will the US Coast Guard Close the 'Icebreaker Gap'?" *Diplomat*, January 14, 2016; Jen Judson, "The Icebreaker Gap," *Politico*, September 1, 2015.

[105] See, for example, Robert D. English, "Why an Arctic Arms Race Would Be a Mistake," *ArcticToday*, June 18, 2020; Paul C. Avey, "The Icebreaker Gap Doesn't Mean America Is Losing in the Arctic," *War on the Rocks*, November 28, 2019; Chuck Hill, "Horrors, It's the Icebreaker Gap (cringe)," *Chuck Hill's CG Blog*, December 21, 2017; Jeremy Hsu, "U.S. Icebreaker Fleet Is Overdue for an Upgrade," *Scientific American*, June 1, 2017; Andreas Kuersten, "Icebreakers and U.S. Power: Separating Fact From Fiction," *War on the Rocks*, October 11, 2016; Andreas Kuersten, "The Dangerous Myth of an 'Icebreaker Gap,'" *Defense One*, September 6, 2016; Andrew C. Revkin, "The U.S. Icebreaker Gap is About Arctic Needs, Not About Chasing Russia," *New York Times (Dot Earth New York Times Blog)*, September 1, 2015.

[106] For additional discussion, see the "Background" section of CRS Report R41153, *Changes in the Arctic: Background and Issues for Congress*, coordinated by Ronald O'Rourke.

[107] See, for example, Liz Ruskin, "Trump Administration May Hire Private Ship to Fill Arctic 'Icebreaker Gap' by Year's End," *Alaska Public Media*, December 14, 2020; Government Accountability Office, *Coast Guard Acquisitions[:] Polar Icebreaker Program Needs to Address Risks before Committing Resources*, GAO-18-600, (continued...)

Table B-1. Major Polar Icebreakers as of April 4, 2022

	Government owned or operated			Privately owned and operated			
	PC1, PC2, or equiv.	PC3, PC4, or equiv.	PC5, PC6, or equiv.	PC1, PC2, or equiv.	PC3, PC4, or equiv.	PC5, PC6, or equiv.	Total
Russia	6 [+2 unavailable]	22	8		9	6	51 [+2 unavailable]
Canada		2	10				12
Finland		7	2				9
United States	1 (*Polar Star*) [+1 nonoperational (*Polar Sea*)]	1 (*Healy*)			1 (*Aiviq*)	2 (*Sikuliaq* and *Palmer*)	5 [+1 nonoperational]
Sweden		4					4
China		1	3				4
Denmark			3				3
Norway		1	1				2
Estonia			2				2
France			1		1		2
United Kingdom		1					1
Japan		1					1
Australia					1		1
Italy			1				1
Latvia			1				1
South Korea			1				1
South Africa			1				1
Argentina			1				1
Chile			1				1
Germany						1	1

Source: Table prepared by CRS based on U.S. Coast Guard graphic of homeports of major polar icebreakers, updated April 4, 2022; provided to CRS by U.S. Coast Guard on August 11, 2022. (An earlier version of the graphic, reflecting data as of May 1, 2017, was posted at https://www.dco.uscg.mil/Portals/9/DCO%20Documents/Office%20of%20Waterways%20and%20Ocean%20Policy/20170501%20major%20icebreaker%20chart.pdf?ver=2017-06-08-091723-907 as of September 21, 2022.) The U.S. Coast Guard states that the vessels shown in the graphic "were selected and organized based on IACS Polar Class notation [see note below], or best equivalent based on publicly available estimates. All vessels included are believed to be capable of independent Arctic or Antarctic operations." The Coast Guard graphic includes the two unavailable Russian government-owned or -operated PC1 or PC2 icebreakers shown above, but it does not include the U.S. nonoperational PC1 or PC2 icebreaker *Polar Sea*, which was added by CRS.

Notes: PC1 through PC6 are IACS (International Association of Classification Societies) classifications for polar-class ships. PC1 through PC5 are ships capable of year-round operation in all polar waters (PC1); moderate multiyear ice conditions (PC2); second-year ice, which may include multiyear ice inclusions (PC3); thick first-year ice, which may include old ice inclusions (PC4); or medium first-year ice, which may include old ice inclusions (PC5). PC6 are ships capable of summer/autumn operation in medium first-year ice, which may include old ice inclusions. (An additional category not shown in the table, PC7, are ships capable of summer/autumn operation in thin first-year ice, which may include old ice inclusions.) Source: *Requirements concerning Polar Class*, International Association of Classification Societies, undated, including Revision 4 of December 2019, Table 1, entitled Polar Class descriptions, p. 11-2.

September 2018, summary page; Norton A. Schwartz and James G. Stavridis, "A Quick Fix for the U.S. 'Icebreaker Gap,'" *Wall Street Journal*, February 3, 2016.

July 2017 National Academies (NASEM) Report

A July 2017 report on the acquisition and operation of polar icebreakers by the National Academies of Sciences, Engineering, and Medicine (NASEM) that was directed by Congress in Section 604 of the Coast Guard Authorization Act of 2015 (H.R. 4188/P.L. 114-120 of February 8, 2016) concluded the following:

> INTRODUCTION
>
> The United States has strategic national interests in the polar regions. In the Arctic, the nation must protect its citizens, natural resources, and economic interests; assure sovereignty, defense readiness, and maritime mobility; and engage in discovery and research. In the Antarctic, the United States must maintain an active presence that includes access to its research stations for the peaceful conduct of science and the ability to participate in inspections as specified in the Antarctic Treaty. The committee's charge... was to advise the U.S. House of Representatives and the U.S. Senate on an assessment of the costs incurred by the federal government in carrying out polar icebreaking missions and on options that could minimize lifecycle costs. The committee's consensus findings and recommendations are presented below. Unless otherwise specified, all estimated costs and prices for the future U.S. icebreakers are expressed in 2019 dollars, since that is the year in which the contracts are scheduled to be made. Supporting material is found in the appendices.
>
> FINDINGS AND RECOMMENDATIONS
>
> **1. Finding: The United States has insufficient assets to protect its interests, implement U.S. policy, execute its laws, and meet its obligations in the Arctic and Antarctic because it lacks adequate icebreaking capability.**
>
> For more than 30 years, studies have emphasized the need for U.S. icebreakers to maintain presence, sovereignty, leadership, and research capacity—but the nation has failed to respond.... The strong warming and related environmental changes occurring in both the Arctic and the Antarctic have made this failure more critical. In the Arctic, changing sea ice conditions will create greater navigation hazards for much of the year, and expanding human industrial and economic activity will magnify the need for national presence in the region. In the Antarctic, sea ice trends have varied greatly from year to year, but the annual requirements for access into McMurdo Station have not changed. The nation is ill-equipped to protect its interests and maintain leadership in these regions and has fallen behind other Arctic nations, which have mobilized to expand their access to ice-covered regions. The United States now has the opportunity to move forward and acquire the capability to fulfill these needs....
>
> **2. Recommendation: The United States Congress should fund the construction of four polar icebreakers of common design that would be owned and operated by the United States Coast Guard (USCG).**
>
> The current Department of Homeland Security (DHS) Mission Need Statement (DHS 2013) contemplates a combination of medium and heavy icebreakers. The committee's recommendation is for a single class of polar icebreaker with heavy icebreaking capability. Proceeding with a single class means that only one design will be needed, which will provide cost savings. The committee has found that the fourth heavy icebreaker could be built for a lower cost than the lead ship of a medium icebreaker class....
>
> The DHS Mission Need Statement contemplated a total fleet of "potentially" up to six ships of two classes—three heavy and three medium icebreakers. Details appear in the High Latitude Mission Analysis Report. The Mission Need Statement indicated that to fulfill its statutory missions, USCG required three heavy and three medium icebreakers; each vessel would have a single crew and would homeport in Seattle. The committee's analysis

indicated that four heavy icebreakers will meet the statutory mission needs gap identified by DHS for the lowest cost. Three of the ships would allow continuous presence in the Arctic, and one would service the Antarctic.

As noted in the High Latitude Report, USCG's employment standard is 185 days away from home port (DAFHP) for a single crew. Three heavy icebreakers in the Arctic provide 555 DAFHP, sufficient for continuous presence. In addition, the medium icebreaker USCG Cutter Healy's design service life runs through 2030. If greater capacity is required, USCG could consider operating three ships with four crews, which would provide 740 DAFHP. The use of multiple crews in the Arctic could require fewer ships while providing a comparable number of DAFHP. For example, two ships (instead of the recommended three) operating in the Arctic with multiple crews could provide a similar number of annual operating days at a lower cost, but such an arrangement may not permit simultaneous operations in both polar regions and may not provide adequate redundancy in capability. More important, an arrangement under which fewer boats are operated more often would require more major maintenance during shorter time in port, often at increasing cost. In addition, if further military presence is desired in the Arctic, USCG could consider ice-strengthening the ninth national security cutter.

One heavy icebreaker servicing the Antarctic provides for the McMurdo breakout and international treaty verification. The availability of the vessel could be extended by homeporting in the Southern Hemisphere. If the single vessel dedicated to the Antarctic is rendered inoperable, USCG could redirect an icebreaker from the Arctic, or it could rely on support from other nations. The committee considers both options to be viable and believes it difficult to justify a standby (fifth) vessel for the Antarctic mission when the total acquisition and lifetime operating costs of a single icebreaker are projected to exceed $1.6 billion. Once the four new icebreakers are operational, USCG can reasonably be expected to plan for more distant time horizons. USCG could assess the performance of the early ships once they are operational and determine whether additional capacity is needed.

USCG is the only agency of the U.S. government that is simultaneously a military service, a law enforcement agency, a marine safety and rescue agency, and an environmental protection agency. All of these roles are required in the mission need statement for a polar icebreaker. USCG, in contrast to a civilian company, has the authorities, mandates, and competencies to conduct the missions contemplated for the polar icebreakers. Having one agency with a multimission capability performing the range of services needed would be more efficient than potentially duplicating effort by splitting polar icebreaker operations among other agencies.

The requirement for national presence is best accomplished with a military vessel. In addition, USCG is fully interoperable with the U.S. Navy and the nation's North Atlantic Treaty Organization partners. USCG is already mandated to operate the nation's domestic and polar icebreakers. Continuing to focus this expertise in one agency remains the logical approach....

Government ownership of new polar icebreakers would be less costly than the use of lease financing (see Appendix C). The government has a lower borrowing cost than any U.S.-based leasing firm or lessor. In addition, the lessor would use higher-cost equity (on which it would expect to make a profit) to cover a portion of the lease financing. The committee's analysis shows that direct purchase by the government would cost, at a minimum, 19 percent less than leasing on a net present value basis (after tax). There is also the risk of the lessor going bankrupt and compromising the availability of the polar icebreaker to USCG. For its analysis, the committee not only relied on its extensive experience with leveraged lease financing but also reviewed available Government Accountability Office reports and Office of Management and Budget rules, examined commercial leasing

economics and current interest rates, and validated its analysis by consulting an outside expert on the issue....

Chartering (an operating lease) is not a viable option.... The availability of polar icebreakers on the open market is extremely limited. (The committee is aware of the sale of only one heavy icebreaker since 2010.) U.S. experience with chartering a polar icebreaker for the McMurdo resupply mission has been problematic on two prior charter attempts. Chartering is workable only if the need is short term and mission specific. The committee notes that chartering may preclude USCG from performing its multiple missions....

In the committee's judgment, an enlarged icebreaker fleet will provide opportunities for USCG to strengthen its icebreaking program and mission. Although the number of billets that require an expert is small compared with the overall number of billets assigned to these icebreakers, more people performing this mission will increase the pool of experienced candidates. This will provide personnel assignment officers with a larger pool of candidates when the more senior positions aboard icebreakers are designated, which will make icebreaking more attractive as a career path and increase the overall level of icebreaking expertise within USCG. Importantly, the commonality of design of the four recommended heavy icebreakers will reduce operating and maintenance costs over the service life of these vessels through efficiencies in supporting and crewing them. Having vessels of common design will likely improve continuity of service, build icebreaking competency, improve operational effectiveness, and be more cost-efficient....

3. Recommendation: USCG should follow an acquisition strategy that includes block buy contracting with a fixed price incentive fee contract and take other measures to ensure best value for investment of public funds.

Icebreaker design and construction costs can be clearly defined, and a fixed price incentive fee construction contract is the most reliable mechanism for controlling costs for a program of this complexity. This technique is widely used by the U.S. Navy. To help ensure best long-term value, the criteria for evaluating shipyard proposals should incorporate explicitly defined lifecycle cost metrics....

A block buy authority for this program will need to contain specific language for economic order quantity purchases for materials, advanced design, and construction activities. A block buy contracting program with economic order quantity purchases enables series construction, motivates competitive bidding, and allows for volume purchase and for the timely acquisition of material with long lead times. It would enable continuous production, give the program the maximum benefit from the learning curve, and thus reduce labor hours on subsequent vessels.

The acquisition strategy would incorporate (a) technology transfer from icebreaker designers and builders with recent experience, including international expertise in design, construction, and equipment manufacture; (b) a design that maximizes use of commercial off-the-shelf (COTS) equipment, applies Polar Codes and international standards, and only applies military specifications (MIL-SPEC) to the armament, aviation, communications, and navigation equipment; (c) reduction of any "buy American" provisions to allow the sourcing of the most

suitable and reliable machinery available on the market; and (d) a program schedule that allows for completion of design and planning before the start of construction. These strategies will allow for optimization of design, reduce construction costs, and enhance reliability and maintainability....

4. Finding: In developing its independent concept designs and cost estimates, the committee determined that the costs estimated by USCG for the heavy icebreaker are reasonable. However, the committee believes that the costs of medium icebreakers identified in the High Latitude Mission Analysis Report are significantly underestimated.

The committee estimates the rough order-of-magnitude (ROM) cost of the first heavy icebreaker to be $983 million. (See Appendix D, Table D-6.) Of these all-in costs, 75 to 80 percent are shipyard design and construction costs; the remaining 20 to 25 percent cover government-incurred costs such as government-furnished equipment and government-incurred program expenses. If advantage is taken of learning and quantity discounts available through the recommended block buy contracting acquisition strategy, the average cost per heavy icebreaker is approximately $791 million, on the basis of the acquisition of four ships. The committee's analysis of the ship size to incorporate the required components (stack-up length) suggests an overall length of 132 meters (433 feet) and a beam of 27 meters (89 feet). This is consistent with USCG concepts for the vessel.

Costs can be significantly reduced by following the committee's recommendations. Reduction of MIL-SPEC requirements can lower costs by up to $100 million per ship with no loss of mission capability.... The other recommended acquisition, design, and construction strategies will control possible cost overruns and provide significant savings in overall life-cycle costs for the program.

Although USCG has not yet developed the operational requirements document for a medium polar icebreaker, the committee was able to apply the known principal characteristics of the USCG Cutter Healy to estimate the scope of work and cost of a similar medium icebreaker. The committee estimates that a first-of-class medium icebreaker will cost approximately $786 million. The fourth ship of the heavy icebreaker series is estimated to cost $692 million. Designing a medium-class polar icebreaker in a second shipyard would incur the estimated engineering, design, and planning costs of $126 million and would forgo learning from the first three ships; the learning curve would be restarted with the first medium design. Costs of building the fourth heavy icebreaker would be less than the costs of designing and building a first-of-class medium icebreaker... . In developing its ROM cost estimate, the committee agreed on a common notional design and basic assumptions.... Two committee members then independently developed cost estimating models, which were validated internally by other committee members. These analyses were then used to establish the committee's primary cost estimate....

5. Finding: Operating costs of new polar icebreakers are expected to be lower than those of the vessels they replace.

The committee expects the operating costs for the new heavy polar icebreakers to be lower than those of USCG's Polar Star. While USCG's previous experience is that operating costs of new cutters are significantly higher than those of the vessels they replace, the committee does not believe this historical experience applies in this case. There is good reason to believe that operating costs for new ships using commercially available modern technology will be lower than costs for existing ships.... The more efficient hull forms and modern engines will reduce fuel consumption, and a well-designed automation plant will require fewer operation and maintenance personnel, which will allow manning to be reduced or freed up for alternative tasks. The use of COTS technology and the minimization of MIL-SPEC, as recommended, will also reduce long-term maintenance costs, since use of customized equipment to meet MIL-SPEC requirements can reduce reliability and increase costs. A new vessel, especially over the first 10 years, typically has significantly reduced major repair and overhaul costs, particularly during dry-dock periods, compared with existing icebreakers—such as the Polar Star—that are near or at the end of their service life.... The Polar Star has many age-related issues that require it to be extensively repaired at an annual dry-docking. These issues will be avoided in the early years of a new ship. However, the committee recognizes that new ship operating costs can be higher than those of older ships if the new ship has more complexity to afford more capabilities. Therefore, any direct comparisons of operating costs of newer versus older ships would need to take into account the benefits of the additional capabilities provided by the newer ship.

USCG will have an opportunity to evaluate the manning levels of the icebreaker in light of the benefits of modern technology to identify reductions that can be made in operating costs....

6. Recommendation: USCG should ensure that the common polar icebreaker design is science-ready and that one of the ships has full science capability.

All four proposed ships would be designed as "science-ready," which will be more cost-effective when one of the four ships—most likely the fourth—is made fully science capable. Including science readiness in the common polar icebreaker design is the most cost-effective way of fulfilling both the USCG's polar missions and the nation's scientific research polar icebreaker needs.... The incremental costs of a science-ready design for each of the four ships ($10 million to $20 million per ship) and of full science capability for one of the ships at the initial build (an additional $20 million to $30 million) are less than the independent design and build cost of a dedicated research medium icebreaker.... In briefings at its first meeting, the committee learned that the National Science Foundation and other agencies do not have budgets to support full-time heavy icebreaker access or the incremental cost of design, even though their science programs may require this capability. Given the small incremental cost, the committee believes that the science capability cited above should be included in the acquisition costs.

Science-ready design includes critical elements that cannot be retrofitted cost-effectively into an existing ship and that should be incorporated in the initial design and build. Among these elements are structural supports, appropriate interior and exterior spaces, flexible accommodation spaces that can embark up to 50 science personnel, a hull design that accommodates multiple transducers and minimizes bubble sweep while optimizing icebreaking capability, machinery arrangements and noise dampening to mitigate interference with sonar transducers, and weight and stability latitudes to allow installation of scientific equipment. Such a design will enable any of the ships to be retrofitted for full science capability in the future, if necessary....

Within the time frame of the recommended build sequence, the United States will require a science-capable polar icebreaker to replace the science capabilities of the Healy upon her retirement. To fulfill this need, one of the heavy polar icebreakers would be procured at the initial build with full science capability; the ability to fulfill other USCG missions would be retained. The ship would be outfitted with oceanographic overboarding equipment and instrumentation and facilities comparable with those of modern oceanographic research vessels. Some basic scientific capability, such as hydrographic mapping sonar, should be acquired at the time of the build of each ship so that environmental data that are essential in fulfilling USCG polar missions can be collected.

7. Finding: The nation is at risk of losing its heavy polar icebreaking capability—experiencing a critical capacity gap—as the Polar Star approaches the end of its extended service life, currently estimated at 3 to 7 years.

The Polar Star, built in 1976, is well past its 30-year design life. Its reliability will continue to decline, and its maintenance costs will continue to escalate. Although the ship went through an extensive life-extending refit in 2011–2012, the Polar Star's useful life is estimated to end between 2020 and 2024. As USCG has recognized, the evaluation of alternative arrangements to secure polar icebreaking capacity is important, given the growing risks of the Polar Star losing its capability to fulfill its mission....

8. Recommendation: USCG should keep the Polar Star operational by implementing an enhanced maintenance program (EMP) until at least two new polar icebreakers are commissioned.

Even if the committee's notional schedule for new polar icebreakers is met, the second polar icebreaker would not be ready until July 2025.... The committee's proposed EMP could be designed with planned—and targeted—upgrades that allow the Polar Star to

> operate every year for its Antarctic mission. The necessary repairs could be performed in conjunction with the ship's current yearly dry-docking schedule within existing annual expenditures, estimated to average $5 million. In particular, the EMP would require improvements in the ship's operating systems, sanitary system, evaporators, main propulsion systems, and controllable pitch propellers. In the committee's judgment, the EMP could be accomplished within USCG's average annual repair expenditures for the Polar Star, which currently range between $2 million and $9 million.[108]

Coast Guard High Latitude Study Provided to Congress in July 2011

In July 2011, the Coast Guard provided to Congress a study on the Coast Guard's missions and capabilities for operations in high-latitude (i.e., polar) areas. The study, commonly known as the High Latitude Study, is dated July 2010 on its cover. The High Latitude Study concluded the following:

> [The study] concludes that future capability and capacity gaps will significantly impact four [Coast Guard] mission areas in the Arctic: Defense Readiness, Ice Operations, Marine Environmental Protection, and Ports, Waterways, and Coastal Security. These mission areas address the protection of important national interests in a geographic area where other nations are actively pursuing their own national goals....
>
> The common and dominant contributor to these significant mission impacts is the gap in polar icebreaking capability. The increasing obsolescence of the Coast Guard's icebreaker fleet will further exacerbate mission performance gaps in the coming years....
>
> The gap in polar icebreaking capacity has resulted in a lack of at-sea time for crews and senior personnel and a corresponding gap in training and leadership. In addition to providing multi-mission capability and intrinsic mobility, a helicopter-capable surface unit would eliminate the need for acquiring an expensive shore-based infrastructure that may only be needed on a seasonal or occasional basis. The most capable surface unit would be a polar icebreaker. Polar icebreakers can transit safely in a variety of ice conditions and have the endurance to operate far from logistics bases. The Coast Guard's polar icebreakers have conducted a wide range of planned and unscheduled Coast Guard missions in the past. Polar icebreakers possess the ability to carry large numbers of passengers, cargo, boats, and helicopters. Polar icebreakers also have substantial command, control, and communications capabilities. The flexibility and mobility of polar icebreakers would assist the Coast Guard in closing future mission performance gaps effectively....
>
> Existing capability and capacity gaps are expected to significantly impact future Coast Guard performance in two Antarctic mission areas: Defense Readiness and Ice Operations. Future gaps may involve an inability to carry out probable and easily projected mission requirements, such as the McMurdo resupply, or readiness to respond to less-predictable events. By their nature, contingencies requiring the use of military capabilities often occur quickly. As is the case in the Arctic, the deterioration of the Coast Guard's icebreaker fleet is the primary driver for this significant mission impact. This will further widen mission performance gaps in the coming years. The recently issued Naval Operations Concept 2010 requires a surface presence in both the Arctic and Antarctic. This further exacerbates the capability gap left by the deterioration of the icebreaker fleet....

[108] National Academies of Sciences, Engineering, and Medicine, Division on Earth and Life Studies and Transportation Research Board, *Acquisition and Operation of Polar Icebreakers: Fulfilling the Nation's Needs*, Letter Report, with cover letter dated July 11, 2017, pp. 9-20.

The significant deterioration of the Coast Guard icebreaker fleet and the emerging mission demands to meet future functional requirements in the high latitude regions dictate that the Coast Guard acquire material solutions to close the capability gaps....

To meet the Coast Guard mission functional requirement, the Coast Guard icebreaking fleet must be capable of supporting the following missions:

- **Arctic North Patrol.** Continuous multimission icebreaker presence in the Arctic.
- **Arctic West Science.** Spring and summer science support in the Arctic.
- **Antarctic, McMurdo Station resupply.** Planned deployment for break-in, supply ship escort, and science support. This mission, conducted in the Antarctic summer, also requires standby icebreaker support for backup in the event the primary vessel cannot complete the mission.
- **Thule Air Base Resupply and Polar Region Freedom of Navigation Transits.** Provide vessel escort operations in support of the Military Sealift Command's Operation Pacer Goose; then complete any Freedom of Navigation exercises in the region.

In addition, the joint Naval Operations Concept establishes the following mission requirements:

- **Assured access and assertion of U.S. policy in the Polar Regions.** The current demand for this mission requires continuous icebreaker presence in both Polar Regions.

Considering these missions, the analysis yields the following findings:

- **The Coast Guard requires three heavy and three medium icebreakers to fulfill its statutory missions.** These icebreakers are necessary to (1) satisfy Arctic winter and transition season demands and (2) provide sufficient capacity to also execute summer missions. Single-crewed icebreakers have sufficient capacity for all current and expected statutory missions. Multiple crewing provides no advantage because the number of icebreakers required is driven by winter and shoulder season requirements. Future use of multiple or augmented crews could provide additional capacity needed to absorb mission growth.
- **The Coast Guard requires six heavy and four medium icebreakers to fulfill its statutory missions and maintain the continuous presence requirements of the Naval Operations Concept.** Consistent with current practice, these icebreakers are single-crewed and homeported in Seattle Washington.
- **Applying crewing and home porting alternatives reduces the overall requirement to four heavy and two medium icebreakers.** This assessment of nonmaterial solutions shows that the reduced number of icebreakers can be achieved by having all vessels operate with multiple crews and two of the heavy icebreakers homeporting in the Southern Hemisphere.

Leasing was also considered as a nonmaterial solution. While there is no dispute that the Coast Guard's polar icebreaker fleet is in need of recapitalization, the decision to acquire this capability through purchase of new vessels, reconstruction of existing ships, or commercial lease of suitable vessels must be resolved to provide the best value to the taxpayer. The multi-mission nature of the Coast Guard may provide opportunities to conduct some subset of its missions with non government-owned vessels. However, serious consideration must be given to the fact that the inherently governmental missions of the Coast Guard must be performed using government-owned and operated vessels. An interpretation of the national policy is needed to determine the resource level that best supports the nation's interests....

> The existing icebreaker capacity, two inoperative heavy icebreakers and an operational medium icebreaker, does not represent a viable capability to the federal government. The time needed to augment this capability is on the order of 10 years. At that point, around 2020, the heavy icebreaking capability bridging strategy expires.[109]

At a July 27, 2011, hearing on U.S. economic interests in the Arctic before the Oceans, Atmosphere, Fisheries, and Coast Guard subcommittee of the Senate Commerce, Science, and Transportation Committee, the following exchange occurred:

> SENATOR OLYMPIA J. SNOWE: On the high latitude study, do you agree with—and those—I would like to also hear from you, Admiral Titley, as well, on these requirements in terms of Coast Guard vessels as I understand it, they want to have—I guess, it was a three medium ice breakers. Am in correct in saying that? Three medium ice breakers.
>
> ADMIRAL ROBERT PAPP, COMMANDANT OF THE COAST GUARD: I agree with the mission analysis and as you look at the requirements for the things that we might do up there, if it is in the nation's interest, it identifies a minimum requirement for three heavy ice breakers and three medium ice breakers and then if you want a persistent presence up there, it would require—and also doing things such as breaking out (inaudible) and other responsibilities, then it would take up to a maximum six heavy and four medium.
>
> SNOWE: Right. Do you agree with that?
>
> PAPP: If we were to be charged with carrying out those full responsibilities, yes, ma'am. Those are the numbers that you would need to do it.
>
> SNOWE: Admiral Titley, how would you respond to the high latitude study and has the Navy conducted its own assessment of its capability?
>
> REAR ADMIRAL DAVID TITLEY, OCEANORGRAPHER AND NAVIGATOR OF THE NAVY: Ma'am, we are in the process right now of conducting what we call a capabilities based assessment that will be out in the summer of this year.
>
> We are getting ready to finish that—the Coast Guard has been a key component of the Navy's task force on climate change, literally since day one when the Chief of Naval Operations set this up, that morning, we had the Coast Guard invited as a member of our executive steering committee.
>
> So we have been working very closely with the Coast Guard, with the Department of Homeland Security, and I think Admiral Papp—said it best as far as the specific comments on the high latitude study but we have been working very closely with the Coast Guard.[110]

January 2011 DHS Office of Inspector General Report

A January 2011 report on the Coast Guard's polar icebreakers from the DHS Office of the Inspector General stated the following:

> The Coast Guard does not have the necessary budgetary control over its [polar] icebreakers, nor does it have a sufficient number of icebreakers to accomplish its missions in the Polar Regions. Currently, the Coast Guard has only one operational [polar] icebreaker [i.e., *Healy*], making it necessary for the United States to contract with foreign nations to perform scientific, logistical, and supply activities. Without the necessary budgetary control and a sufficient number of icebreaking assets, the Coast Guard will not have the capability to perform all of its missions, will lose critical icebreaking expertise, and may be beholden to foreign nations to perform its statutory missions. The Coast Guard should improve its strategic approach to ensure that it has the long-term icebreaker capabilities

[109] *United States Coast Guard High Latitude Region Mission Analysis Capstone Summary*, July 2010, pp. 10-13, 15.

[110] Source: Transcript of hearing.

> needed to support Coast Guard missions and other national interests in the Arctic and Antarctic regions.[111]

Regarding current polar icebreaking capabilities for performing Arctic missions, the report states the following:

> The Coast Guard's icebreaking resources are unlikely to meet future demands. [The table below] outlines the missions that Coast Guard is unable to meet in the Arctic with its current icebreaking resources.

Arctic Missions Not Being Met

Requesting Agency	Missions Not Being Met
United States Coast Guard	—Fisheries enforcement in Bering Sea to prevent foreign fishing in U.S. waters and overfishing —Capability to conduct search and rescue in Beaufort Sea for cruise line and natural resource exploration ships —Future missions not anticipated to be met: 2010 Arctic Winter Science Deployment
NASA	Winter access to the Arctic to conduct oceanography and study Arctic currents and how they relate to regional ice cover, climate, and biology
NOAA and NSF	Winter research
Department of Defense	Assured access to ice-impacted waters through a persistent icebreaker presence in the Arctic and Antarctic[112]

The report also states the following:

> Should the Coast Guard not obtain funding for new icebreakers or major service life extensions for its existing icebreakers with sufficient lead-time, the United States will have no heavy icebreaking capability beyond 2020 and no polar icebreaking capability of any kind by 2029. Without the continued use of icebreakers, the United States will lose its ability to maintain a presence in the Polar Regions, the Coast Guard's expertise to perform ice operations will continue to diminish, and missions will continue to go unmet.[113]

[111] Department of Homeland Security, Office of Inspector General, *The Coast Guard's Polar Icebreaker Maintenance, Upgrade, and Acquisition Program*, OIG-11-31, January 2011, p. 1 (Executive Summary). Report accessed September 21, 2011, at https://www.oig.dhs.gov/assets/Mgmt/OIG_11-31_Jan11.pdf.

[112] Department of Homeland Security, Office of Inspector General, *The Coast Guard's Polar Icebreaker Maintenance, Upgrade, and Acquisition Program*, OIG-11-31, January 2011, p. 9.

[113] Department of Homeland Security, Office of Inspector General, *The Coast Guard's Polar Icebreaker Maintenance, Upgrade, and Acquisition Program*, OIG-11-31, January 2011, p. 10.

Regarding current polar icebreaking capabilities for performing Antarctic missions, the report states the following:

> The Coast Guard needs additional icebreakers to accomplish its missions in the Antarctic. The Coast Guard has performed the McMurdo Station resupply in Antarctica for decades, but with increasing difficulty in recent years. The Coast Guard's two heavy-duty icebreakers [i.e., *Polar Star* and *Polar Sea*] are at the end of their service lives, and have become less reliable and increasingly costly to keep in service....
>
> In recent years, the Coast Guard has found that ice conditions in the Antarctic have become more challenging for the resupply of McMurdo Station. The extreme ice conditions have necessitated the use of foreign vessels to perform the McMurdo break-in....
>
> As ice conditions continue to change around the Antarctic, two icebreakers are needed for the McMurdo break-in and resupply mission. Typically, one icebreaker performs the break-in and the other remains on standby. Should the first ship become stuck in the ice or should the ice be too thick for one icebreaker to complete the mission, the Coast Guard deploys the ship on standby. Since the Polar Sea and Polar Star are not currently in service, the Coast Guard has no icebreakers capable of performing this mission. [The table below] outlines the missions that will not be met without operational heavy-duty icebreakers.

Arctic Missions Not Being Met

Requesting Agency	Missions Not Being Met
NSF	Missions not anticipated to be met: 2010-2011 Operation Deep Freeze – McMurdo Station Resupply
Department of State	Additional inspections of foreign facilities in Antarctica to enforce the Antarctic Treaty and ensure facilities' environment compliance[114]

The report's conclusion and recommendations were as follows:

> **Conclusion**
>
> With an aging fleet of three icebreakers, one operational and two beyond their intended 30-year service life, the Coast Guard is at a critical crossroads in its Polar Icebreaker Maintenance, Upgrade, and Acquisition Program. It must clarify its mission requirements, and if the current mission requirements remain, the Coast Guard must determine the best method for meeting these requirements in the short and long term.
>
> **Recommendations**
>
> We recommend that the Assistant Commandant for Marine Safety, Security, and Stewardship:
>
> **Recommendation #1:** Request budgetary authority for the operation, maintenance, and upgrade of its icebreakers.
>
> **Recommendation #2:** In coordination with the Department of Homeland Security, request clarification from Congress to determine whether Arctic missions should be performed by Coast Guard assets or contracted vessels.

[114] Department of Homeland Security, Office of Inspector General, *The Coast Guard's Polar Icebreaker Maintenance, Upgrade, and Acquisition Program*, OIG-11-31, January 2011, pp. 10-11.

> **Recommendation #3:** In coordination with the Department of Homeland Security, request clarification from Congress to determine whether Antarctic missions should be performed by Coast Guard assets or contracted vessels.
>
> **Recommendation #4:** Conduct the necessary analysis to determine whether the Coast Guard should replace or perform service-life extensions on its two existing heavy-duty icebreaking ships.
>
> **Recommendation #5:** Request appropriations necessary to meet mission requirements in the Arctic and Antarctic.[115]

The report states that

> The Coast Guard concurred with all five of the recommendations and is initiating corrective actions. We consider the recommendations open and unresolved. The Coast Guard provided information on some of its ongoing projects that will address the program needs identified in the report.[116]

2010 U.S. Arctic Research Commission Report

A May 2010 report from the U.S. Arctic Research Commission (USARC) on goals and objectives for Arctic research for 2009-2010 stated the following:

> To have an effective Arctic research program, the United States must invest in human capital, research platforms, and infrastructure, including new polar class icebreakers, and sustained sea, air, land, space, and social observing systems.... The Commission urges the President and Congress to commit to replacing the nation's two polar class icebreakers.[117]

2007 National Research Council Report

A 2007 National Research Council (NRC) report, *Polar Icebreakers in a Changing World: An Assessment of U.S. Needs*, assessed roles and future needs for Coast Guard polar icebreakers.[118] The study was required by report language accompanying the FY2005 DHS appropriations act (H.R. 4567/P.L. 108-334).[119] The study was completed in 2006 and published in 2007. Some

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[115] Department of Homeland Security, Office of Inspector General, *The Coast Guard's Polar Icebreaker Maintenance, Upgrade, and Acquisition Program*, OIG-11-31, January 2011, p. 12.

[116] Department of Homeland Security, Office of Inspector General, *The Coast Guard's Polar Icebreaker Maintenance, Upgrade, and Acquisition Program*, OIG-11-31, January 2011, p. 13.

[117] U.S. Arctic Research Commission, *Report on Goals and Objectives for Arctic Research 2009-2010, May 2010*, p. 4. Accessed online December 5, 2011, at https://storage.googleapis.com/arcticgov-static/publications/goals/usarc_goals_2009-10.pdf.

[118] National Research Council, *Polar Icebreakers in a Changing World, An Assessment of U.S. Needs*, Washington, 2007, 122 pp.

[119] H.R. 4567/P.L. 108-334 of October 18, 2004. The related Senate bill was S. 2537. The Senate report on S. 2537 (S.Rept. 108-280 of June 17, 2004) stated the following:

> The Committee expects the Commandant to enter into an arrangement with the National Academy of Sciences to conduct a comprehensive study of the role of Coast Guard icebreakers in supporting United States operations in the Antarctic and the Arctic. The study should include different scenarios for continuing those operations including service life extension or replacement of existing Coast Guard icebreakers and alternative methods that do not use Coast Guard icebreakers. The study should also address changes in the roles and missions of Coast Guard icebreakers in support of future marine operations in the Arctic that may develop due to environmental change, including the amount and kind of icebreaking support that may be required in the future to support marine operations in the Northern Sea Route and the Northwest Passage; the suitability of the Polar Class icebreakers for these new roles; and appropriate changes in existing laws governing Coast Guard

(continued...)

sources refer to the study as the 2006 NRC report. The report made the following conclusions and recommendations:

> Based on the current and future needs for icebreaking capabilities, the [study] committee concludes that the nation continues to require a polar icebreaking fleet that includes a minimum of three multimission ships [like the Coast Guard's three current polar icebreakers] and one single-mission [research] ship [like Palmer]. The committee finds that although the demand for icebreaking capability is predicted to increase, a fleet of three multimission and one single-mission icebreakers can meet the nation's future polar icebreaking needs through the application of the latest technology, creative crewing models, wise management of ice conditions, and more efficient use of the icebreaker fleet and other assets. The nation should immediately begin to program, design, and construct two new polar icebreakers to replace the POLAR STAR and POLAR SEA.
>
> Building only one new polar icebreaker is insufficient for several reasons. First, a single ship cannot be in more than one location at a time. No matter how technologically advanced or efficiently operated, a single polar icebreaker can operate in the polar regions for only a portion of any year. An icebreaker requires regular maintenance and technical support from shipyards and industrial facilities, must reprovision regularly, and has to effect periodic crew changeouts. A single icebreaker, therefore, could not meet any reasonable standard of active and influential presence and reliable, at-will access throughout the polar regions.
>
> A second consideration is the potential risk of failure in the harsh conditions of polar operations. Despite their intrinsic robustness, damage and system failure are always a risk and the U.S. fleet must have enough depth to provide backup assistance. Having only a single icebreaker would necessarily require the ship to accept a more conservative operating profile, avoiding more challenging ice conditions because reliable assistance would not be available. A second capable icebreaker, either operating elsewhere or in homeport, would provide ensured backup assistance and allow for more robust operations by the other ship.
>
> From a strategic, longer-term perspective, two new Polar class icebreakers will far better position the nation for the increasing challenges emerging in both polar regions. A second new ship would allow the U.S. Coast Guard to reestablish an active patrol presence in U.S. waters north of Alaska to meet statutory responsibilities that will inevitably derive from increased human activity, economic development, and environmental change. It would allow response to emergencies such as search-and-rescue cases, pollution incidents, and assistance to ships threatened with grounding or damage by ice. Moreover, a second new ship will leverage the possibilities for simultaneous operations in widely disparate geographic areas (e.g., concurrent operations in the Arctic and Antarctic), provide more flexibility for conducting Antarctic logistics (as either the primary or the secondary ship for the McMurdo break-in), allow safer multiple-ship operations in the most demanding ice conditions, and increase opportunities for international expeditions. Finally, an up-front decision to build two new polar icebreakers will allow economies in the design and construction process and provide a predictable cost reduction for the second ship....
>
> The [study] committee finds that both operations and maintenance of the polar icebreaker fleet have been underfunded for many years, and the capabilities of the nation's icebreaking

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> icebreaking operations and the potential for new operating regimes. The study should be submitted to the Committee no later than September 30, 2005.

The conference report on H.R. 4567 (H.Rept. 108-774 of October 9, 2004) stated the following:

> As discussed in the Senate report and the Coast Guard authorization bill for fiscal year 2005, the conferees require the National Academy of Sciences to study the role of Coast Guard icebreakers.

The earlier House report on H.R. 4567 (H.Rept. 108-541 of June 15, 2004) contained language directing a similar report from the Coast Guard rather than the National Academies. (See the passage in the House report under the header "Icebreaking.")

fleet have diminished substantially. Deferred long-term maintenance and failure to execute a plan for replacement or refurbishment of the nation's icebreaking ships have placed national interests in the polar regions at risk. The nation needs the capability to operate in both polar regions reliably and at will. Specifically, the committee recommends the following:

- The United States should continue to project an active and influential presence in the Arctic to support its interests. This requires U.S. government polar icebreaking capability to ensure year-round access throughout the region.
- The United States should continue to project an active and influential presence in the Antarctic to support its interests. The nation should reliably control sufficient icebreaking capability to break a channel into and ensure the maritime resupply of McMurdo Station.
- The United States should maintain leadership in polar research. This requires icebreaking capability to provide access to the deep Arctic and the ice-covered waters of the Antarctic.
- National interests in the polar regions require that the United States immediately program, budget, design, and construct two new polar icebreakers to be operated by the U.S. Coast Guard.
- To provide continuity of U.S. icebreaking capabilities, the POLAR SEA should remain mission capable and the POLAR STAR should remain available for reactivation until the new polar icebreakers enter service.
- The U.S. Coast Guard should be provided sufficient operations and maintenance budget to support an increased, regular, and influential presence in the Arctic. Other agencies should reimburse incremental costs associated with directed mission tasking.
- Polar icebreakers are essential instruments of U.S. national policy in the changing polar regions. To ensure adequate national icebreaking capability into the future, a Presidential Decision Directive should be issued to clearly align agency responsibilities and budgetary authorities.[120]

The Coast Guard stated in 2008 that it "generally supports" the NRC report, and that the Coast Guard "is working closely with interagency partners to determine a way forward with national polar policy that identifies broad U.S. interests and priorities in the Arctic and Antarctic that will ensure adequate maritime presence to further these interests. Identification and prioritization of U.S. national interests in these regions should drive development of associated USCG [U.S. Coast Guard] capability and resource requirements." The Coast Guard also stated the following: "Until those broad U.S. interests and priorities are identified, the current USG [U.S. Government] polar icebreaking fleet should be maintained in an operational status."[121]

[120] National Research Council, *Polar Icebreakers in a Changing World, An Assessment of U.S. Needs*, Washington, 2007, pp. 2-3.

[121] Coast Guard point paper provided to CRS on February 12, 2008, and dated with the same date, providing answers to questions from CRS concerning polar icebreaker modernization.

Appendix C. Great Lakes Icebreakers

This appendix provides additional background information on the Coast Guard's Great Lakes icebreakers.

The Coast Guard's current Great Lakes icebreaker fleet consists of nine cutters:

- one heavy icebreaker—*Mackinaw* (WLBB-30), a 240-foot ship displacing 3,500 tons (**Figure C-1**);
- six 140-foot *Bay*-class icebreaking tugs displacing 662 tons each; and
- two 225-foot *Juniper*-class seagoing buoy tenders displacing about 2,000 tons each that have a light icebreaking capability.[122]

Figure C-1. Great Lakes Icebreaker *Mackinaw*

Source: U.S. Coast Guard, "USCGC Mackinaw," accessed September 11, 2019, at https://www.atlanticarea.uscg.mil/Our-Organization/District-9/Ninth-District-Staff/Prevention-Division/Cutters/MACKINAW/.

Although *Mackinaw* is referred to as a heavy icebreaker, the word *heavy* in this instance is being used in the context of Great Lakes icebreaking—*Mackinaw* is much larger and has more icebreaking capability than the eight icebreaking tugs and seagoing buoy tenders ships listed above.[123] *Mackinaw* would not, however, qualify as a heavy polar icebreaker, as it is much smaller and has much less icebreaking capability than a heavy polar icebreaker.[124]

[122] Source: U.S. Coast Guard, "Ninth Coast Guard District Units," accessed December 12, 2023, at https://www.atlanticarea.uscg.mil/Atlantic-Area/Units/District-9/Ninth-District-Units/. A total of 10 cutters are assigned to the Ninth District, which is responsible for the Great Lakes, the Saint Lawrence Seaway, and parts of the surrounding states. The tenth cutter assigned to the Ninth District is a 100-foot inland buoy tender whose primary missions do not include icebreaking.

[123] At continuous speeds of 3 knots, *Mackinaw* can break ice up to 32 inches thick, the 140-foot icebreaking tugs can break ice up to 22 inches thick, and the 225-foot seagoing buoy tenders can break ice up to 14 inches thick.

[124] As discussed elsewhere in this report, the Coast Guard's two heavy polar icebreakers—the operational *Polar Star* (continued...)

Supporters of procuring an additional Great Lakes icebreaker with capabilities generally similar to those of *Mackinaw* generally have argued the following:

- The 2014 and 2015 ice seasons were a 20-year anomaly, but the Coast Guard should have a capability for supporting maritime commerce in above-average ice seasons. About 24% of recent years (11 out of 46 years) featured 75% or higher ice coverage. The economic consequences of ice-related restrictions on navigation can be significant.
- The Coast Guard's Great Lakes icebreaking capability is less sufficient for meeting winter needs than the size of Coast Guard's current Great Lakes icebreaker fleet might suggest because some of the icebreakers are sometimes not available for duty, because the Coast Guard reports ice-related navigation restrictions for only some of the area's commercial waterways and not others, and because the Coast Guard defines a waterway as restricted or closed when two commercial ships get stuck in the ice in certain waterways, overlooking instances where commercial ship operators decline to operate their ships on those waters because they assess a high risk of the ships getting stuck.
- While the Canadian Coast Guard usually assigns one or more additional icebreakers to the St. Lawrence River and the Great Lakes in severe ice seasons, Canadian Coast Guard ships operating there provide icebreaking assistance to U.S. commercial ships only under certain circumstances, resulting in only a small amount of icebreaking assistance being provided to U.S. commercial ships.

A February 2, 2022, press report states

> A lack of U.S. Coast Guard icebreaking assets has delayed cargoes this season on the Great Lakes despite a relatively mild and delayed onset of winter in the region, the Great Lakes Maritime Task Force said Wednesday [February 2].
>
> U.S.-flag "lakers" on 20 voyages, with a total of 750,000 tons of carrying capacity for iron ore, coal and cement, were delayed for a total of 325 hours, the group said.
>
> The Great Lakes Maritime Task Force, with 74 members, is the largest coalition to speak for the Great Lakes Navigation System.
>
> In one case involving the MV American Century, the ship became beset in the St. Mary's River even after it cleared a regulatory check-in point in time to meet the scheduled closing of the Soo Locks in Sault Ste. Marie, Michigan. Coast Guard icebreakers were unable to free the vessel in time for its planned transit through the locks, which connect Lake Superior to Lake Huron. This delayed the downbound lockage's of the last vessels leaving Lake Superior, including the Coast Guard Cutter Biscayne Bay, which left no icebreakers on Lake Superior during the lock closure.
>
> The U.S. Coast Guard Cutter Alder, which is normally stationed in Duluth, Minnesota, is on the East Coast for an overhaul.
>
> The ice-induced vessel delays also forced the Army Corps of Engineers to begin lock dewatering operations a day later than planned.

and the nonoperational *Polar Sea*—are 399 feet long and displace about 13,200 tons each. *Polar Star* can break ice up to six feet (72 inches) thick at a continuous speed of 3 knots. The Coast Guard states that *Mackinaw* is equivalent to the Canadian Coast Guard ship *Samuel Risley*, a Great Lakes-homeported icebreaker and buoy tender that Canada classifies as a light icebreaker in a comparison conducted across its entire icebreaking fleet, including its Arctic icebreakers. (U.S. Coast Guard, *Great Lakes Icebreaking Mission Analysis, Fiscal Year 2016 Report to Congress*, August 30, 2016, p. 5.)

> "The inefficiency introduced into the Great Lakes Navigation System by inadequate Coast Guard icebreaking resources impacts the carriers, their customers and the entire North American Manufacturing supply chain," said Jim Weakley, President of Great Lakes Maritime Task Force, and the Lake Carriers' Association. "The men and women of the U.S. Coast Guard do the best they can with the resources they are provided. Unfortunately, they do not have enough icebreakers to keep the system operating efficiently."
>
> Coast Guard icebreaking operations on the Great Lakes, known as Operation Taconite, typically begin on December 15, giving icebreaking assets one month before the scheduled closure of the Soo Locks on January 15. But this year the icebreaking operation was delayed until December 29, and the U.S. Coast Guard had four of its nine Great Lakes icebreakers in scheduled overhaul, scheduled maintenance, or unscheduled maintenance periods, according to the task force, and at one point in January, five of its eight icebreakers operating on the Great Lakes were simultaneously unavailable due to mechanical failures. A total of 68 icebreaking cutter days were lost due to equipment fires or engine breakdowns, the task force said.
>
> "The lives of the professional women and men sailing aboard lakers, the safety of the vessels and the protection of the environment depend on adequate Coast Guard icebreakers," said John Clemons, Great Lakes Maritime Task Force's Vice President and with American Maritime Officers, AFL-CI). "In recent years, vessels have been sliced open, forced aground or collided with each other because of inadequate icebreaking resources."
>
> "The Port of Duluth-Superior is the Great Lakes' top port by tonnage and one of the nation's top twenty, but the Coast Guard doesn't consider its waterways as 'Tier I' for icebreaking purposes," says Deb DeLuca, executive director, Duluth Seaway Port Authority. "This is troubling given that Minnesota's docks along the western edge of Lake Superior provide the iron ore to produce 80 percent of the nation's first-pour steel. The Head of the Lakes is a vital link in North America's domestic steel production supply chain."
>
> "Adequate icebreaking not only supports the Great Lakes Navigation System, but it also prevents flooding," said Eric Peace, the Lake Carriers' Associations' Vice President and an experienced sailor. "Last February, we saw extensive flooding because of an ice dam in the St. Clair River. At the time the lone 'heavy' icebreaker operated by the Coast Guard was not available because it was undergoing repairs."[125]

Prior to October 2021, the Coast Guard generally stated that it did not view the procurement of additional Great Lakes icebreakers as an urgent near-term acquisition need, given the capabilities of the current Great Lakes icebreaking fleet, the relatively young age of *Mackinaw* (which entered service in 2006), service life extension work being done on the ice-breaking tugs that is designed to add 15 years to their service lives, and Canada's own Great Lakes icebreaking capabilities.[126]

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[125] Mike Schuler, "Lack of Coast Guard Icebreakers Disrupts Shipping on Great Lakes, Says Task Force," *gCaptain*, February 2, 2022. See also Julie Riddle, "Icebreaker Shortage Slows Deliveries to Alpena, Other Ports," *Alpena [MI] News*, February 3, 2022.

[126] A 2016 Coast Guard report to Congress on the Great Lakes icebreaking mission, for example, stated the following:

> The current mix of heavy and medium [Great Lakes] icebreakers is capable of managing priorities and requests for icebreaking in Tier 1 and 2 waterways. When a severe ice season stresses Coast Guard asset capabilities, the existing agreement and partnership with Canada fills the capability gap and brings in extra heavy-icebreaking resources to manage the ice.... [T]he 2014 and 2015 ice seasons were a 20-year anomaly, consuming almost twice as many cutter resource hours as in any other year since 2005.

(continued...)

In October 2021, then-Commandant of the Coast Guard Admiral Karl Schultz expressed support for procuring an additional heavy Great Lakes icebreaker as part of a budget reconciliation bill. At an October 19, 2021, hearing on Coast Guard oversight before the Oceans, Fisheries, Climate Change, and Manufacturing subcommittee of the Senate Commerce, Science, and Transportation Committee, the following exchange occurred:

> SENATOR TAMMY BALDWIN:
>
> Thank you. I want to start this round of questions by talking about the Great Lakes icebreaker. Climate change does not mean the end of cold winters in the Great Lakes. In fact, three of the worst Great Lakes ice seasons of the past several decades have occurred during the last seven years. By one estimate, these three winters cost our region's economic—economy approximately $2 billion with 10,000 jobs lost due to reductions in maritime commerce and the resulting impacts on manufacturers in the region.
>
> Climate change is also contributing to more extreme weather events, larger quantities of precipitation, and higher lake levels. During the winter, this results in greater risk of flooding because ice collects in rivers to form ice dams, our communities rely on Coast Guard icebreakers to break up these ice dams and prevent flooding in our communities.
>
> From transportation to saving lives and property from flooding, we need more icebreakers, and that's why I'm fighting for a new Great Lakes icebreaker to be funded in our current budget reconciliation bill. Admiral Schultz, yes or no, do you support funding for a new Great Lakes icebreaker in the reconciliation package?
>
> COAST GUARD COMMANDANT ADMIRAL KARL SCHULTZ:
>
> Madam Chair, funding in the reconciliation packs [sic: package], absolutely, yeah, in support of that.
>
> BALDWIN:
>
> Great. I appreciate your support, Admiral. During the time—during the Lake Michigan ice jam caused flooding last winter, the Coast Guard's only Great Lakes heavy icebreaker was not available, and smaller icebreaking cutters struggled to break through that ice jam. While the Coast Guard eventually accomplished their mission with the current assets, if a second heavy icebreaker had been available last winter, the Coast Guard could have provided more flood relief, more quickly, would you agree?
>
> SCHULTZ:
>
> Senator, I don't have all the specifics around that. I would say, clearly, more capacity and a bigger breaker versus a small breaker, that's sort of common sense, I would say. You know, depending on what's going on at the time, we could find one breaker, you know, in one part of the Great Lakes, having sailed up there is quite a great distances [sic].

The Coast Guard cannot reliably predict the economic impact of maintaining a single heavy Great Lakes icebreaker. Additionally, given the extreme conditions when ice coverage exceeds 90 percent, it is not clear that shipping delays would be significantly mitigated by an increase in icebreaking capability. Delays can be associated with several factors such as slow transit speeds, availability of pilots, and simultaneous and competing demand signals for icebreaking services across the Great Lakes.

(U.S. Coast Guard, *Great Lakes Icebreaking Mission Analysis, Fiscal Year 2016 Report to Congress*, August 30, 2016, p. 11. The report was required by S.Rept. 114-68 of June 18, 2015, the Senate Appropriations Committee's report on S. 1619, the Department of Homeland Security Appropriations Bill, 2016 (see page 75).)

> But I think, additional capacity—additional heavy capacity and capability is probably a positive there that could have lend to better outcomes there. Yes.[127]

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Disclaimer

[127] Transcript of hearing as posted at CQ.com.