



The Navy's Costs to Eliminate Its Deferred Maintenance Backlog and to Renovate and Modernize Its Buildings



At a Glance

The Navy has more than 175,000 buildings and other structures on its bases. Altogether, those facilities cost billions of dollars each year to maintain—but funding for their maintenance has regularly fallen short of amounts that the Navy estimates would keep them in working order. As a result, the Navy faces a backlog of deferred maintenance. The costs of performing that maintenance and further renovating and modernizing the Navy’s deteriorated buildings may be significant.

In this report, the Congressional Budget Office analyzes the condition of roughly 20,000 buildings that the active Navy (excluding the Navy Reserve and the Marine Corps) uses and maintains on its bases (also called installations) in the United States. For that group of buildings, CBO estimated two types of costs:

- The cost of eliminating maintenance backlogs and raising the condition of the buildings to the Navy’s standards would be \$17 billion (in 2020 dollars), and
- The cost of renovating and modernizing the buildings within their current footprint (the area they cover on the ground) to fully support their users’ missions would be an additional \$32 billion.

On average, completing those buildings’ maintenance and their renovation and modernization would cost nearly half as much as replacing them altogether.

CBO based its estimates on the most recent data provided by the Navy, which were current as of September 2020. Since then, the prices of goods and services in the United States have risen considerably, so the costs of maintaining and renovating Navy buildings have probably increased as well—and may continue to rise, especially if inflation persists. The estimates of costs in this report do not account for those effects, nor do they account for the effects of current efforts to modernize facilities in the Navy’s shipyards.

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Notes

This Congressional Budget Office report is the second in a series focusing on the military services' costs of deferred maintenance and of renovation and modernization. CBO discussed its analysis of such costs for the Army in its November 2022 report *The Army's Costs to Eliminate Its Deferred Maintenance Backlog and to Renovate and Modernize Its Buildings* (www.cbo.gov/publication/58220). In that report, CBO analyzed roughly 49,000 buildings in use on Army bases in the United States that the Army's active component is responsible for maintaining. CBO estimated that the cost of eliminating the maintenance backlog and returning the buildings to standards matching the Department of Defense's goals would be about \$19 billion (in 2020 dollars), and the cost of renovating and modernizing the buildings within their current footprint to fully support their users' missions would be an additional \$34 billion.

All years referred to in this report are federal fiscal years, which run from October 1 to September 30 and are designated by the calendar year in which they end.

Numbers in the text, table, and figures may not add up to totals because of rounding.

Funding and costs are expressed in 2020 dollars.

CBO used data from the Navy in the Department of Defense's Real Property Information Model (version 10.0) to produce all of the exhibits in this report.

On the cover: ships from various nations moored at Joint Base Pearl Harbor-Hickam, Hawaii, during Rim of the Pacific, the world's largest international maritime exercise, in 2022 (U.S. Navy photo by Mass Communication Specialist Seaman Leon Vonguyen).

The Navy's Costs to Eliminate Its Deferred Maintenance Backlog and to Renovate and Modernize Its Buildings

The Navy's bases (formally known as installations) are home to about 176,000 **real property assets**—buildings, piers, and other structures. That infrastructure supports military forces by providing facilities for training, storing equipment, housing troops, and other activities, but it must compete with other high-priority purposes for funds. Over time, insufficient funding for the maintenance of the Navy's real property assets has allowed their condition to degrade.

In this report, the Congressional Budget Office focuses on a subset of those assets: roughly 20,000 buildings maintained by the active Navy and currently in use on 59 bases in the United States and its territories. CBO analyzed data on the buildings' age, condition, and capacity to support their users' missions. The agency then estimated how much it would cost to complete their deferred maintenance. CBO also estimated the costs of renovating and modernizing the buildings to fully support their users' missions.

Deferred maintenance, by definition, is maintenance that the Navy's real property managers want to undertake but that has not been carried out. It includes regular preventative maintenance and repairs to improve property's condition to meet the Navy's standards. Failure to perform such maintenance could accelerate the natural degradation of property and substantially increase the costs of renovations in the future.

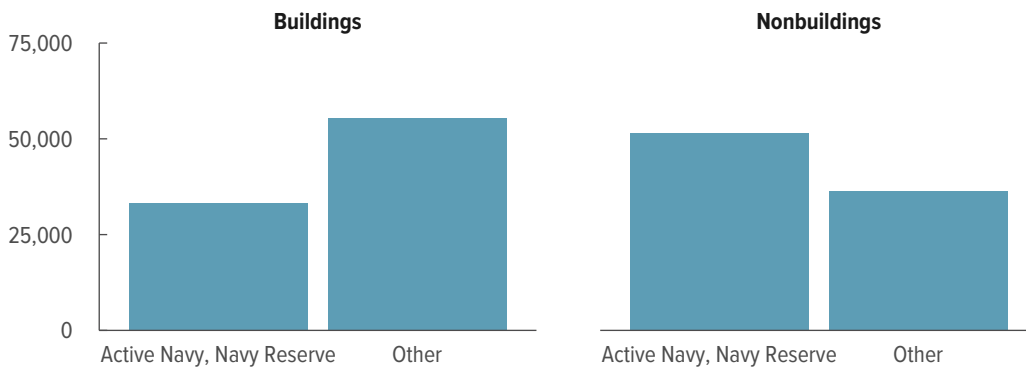
The Department of the Navy's Real Property

As of September 2020, there were 176,000 real property assets on Navy bases worldwide. That portfolio included nearly 90,000 buildings of various types, such as administrative headquarters and maintenance shops, that covered about 693 million square feet of space and had a replacement value of roughly \$327 billion. It also included about 90,000 nonbuilding structures, such as piers, pipelines, and storage tanks.

The active Navy and Navy Reserve maintain 48 percent of those assets. Other organizations—the Marine Corps, defense agencies (such as the Defense Logistics Agency), and private entities—are responsible for maintaining the rest.

Real Properties on Navy Bases, by Type and Organization Responsible for Maintenance

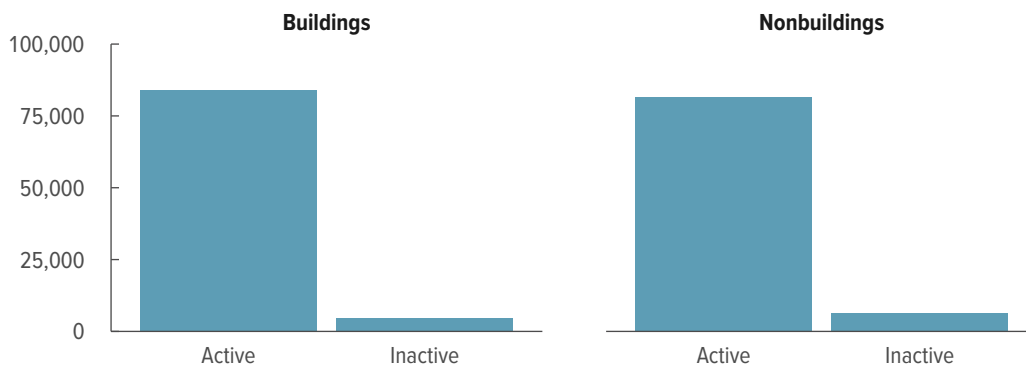
Number of Real Properties



The active Navy and the Navy Reserve are responsible for maintaining roughly 85,000 real property assets on Navy bases. Other properties on Navy bases are maintained by private organizations or other defense agencies.

Real Properties on Navy Bases, by Type and Operational Status

Number of Real Properties



Most real property assets on Navy bases—about 94 percent—are actively used.

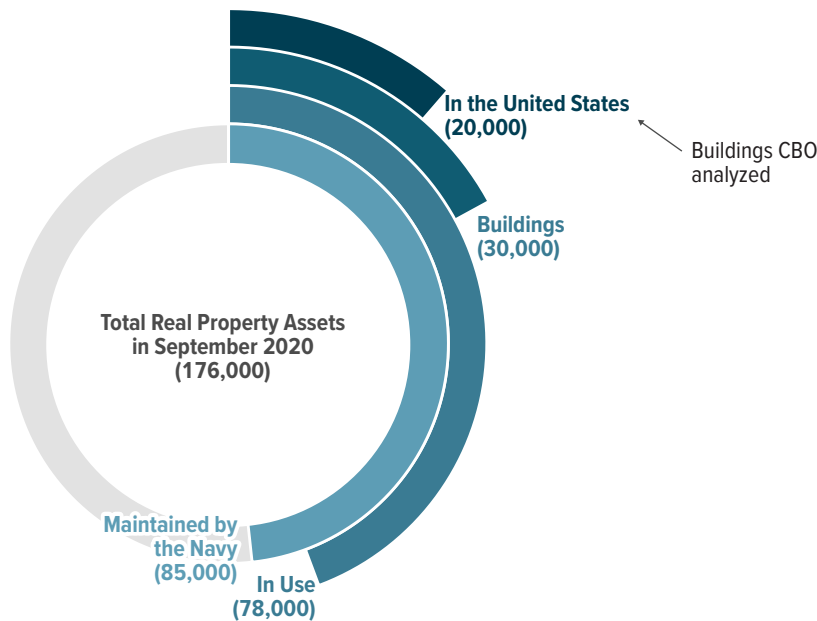
Real Property Assets Considered in CBO's Analysis

For this analysis, CBO focused on 20,000 real property assets from the Navy's inventory. Those assets met the following criteria:

- The active Navy was responsible for maintaining them. (CBO excluded buildings maintained by the Navy Reserve and buildings maintained by other entities, such as the Defense Logistics Agency and private organizations.)¹
- They were in active use.
- They were buildings—not nonbuilding structures such as pipelines and piers.
- They were located on Navy bases inside the United States and its territories.

CBO used data from the Department of Defense's (DoD's) Real Property Information Model to estimate the buildings' maintenance costs and average characteristics. Although some entries in the database were missing, the data for assets that met CBO's sampling criteria were sufficient to produce those estimates.

Navy Buildings Considered in CBO's Analysis



Of the 176,000 real properties located on Navy bases worldwide in 2020, CBO focused on 20,000, or 11 percent. Those buildings were in use in the United States or its territories and were maintained by the active Navy.

Characteristics of the Buildings Considered in CBO's Analysis

According to the Navy, the **replacement value** of the 20,000 buildings considered in CBO's analysis—that is, the cost to replace them with buildings of similar type and quality—was about \$111 billion in 2020. The total **book value**—calculated by deducting accumulated depreciation from original costs—was about \$14 billion. The buildings covered 243 million square feet of space.

The Navy considers a building's **intended useful life** to last as long as it has a positive book value. On average, the buildings in CBO's analysis were 48 years old, and their intended useful life, as estimated by the Navy, was 49 years; about 46 percent of the buildings had exceeded their intended useful life. Separately, DoD has expressed a goal to restore, modernize, or replace facilities once every 67 years. About 30 percent of the buildings CBO analyzed had reached that age.

On average, the **utilization rate** of the buildings was 86 percent. DoD defines that rate as the ratio of space used when operating at full capacity to the total space available in the buildings.

Characteristics of Navy Buildings in CBO's Analysis

Replacement Value (Cumulative)	\$111 billion
Book Value (Cumulative)	\$14 billion
Area (Cumulative)	243 million square feet
Estimated Useful Life (Average)	49 years
Age (Average)	48 years
Share of Buildings Exceeding Their Intended Useful Life	46 percent (9,200 of 20,000)
Utilization Rate (Average)	86 percent

The replacement value of the buildings CBO analyzed was roughly eight times their book value. Almost half of the buildings had been in use for longer than their intended useful life.

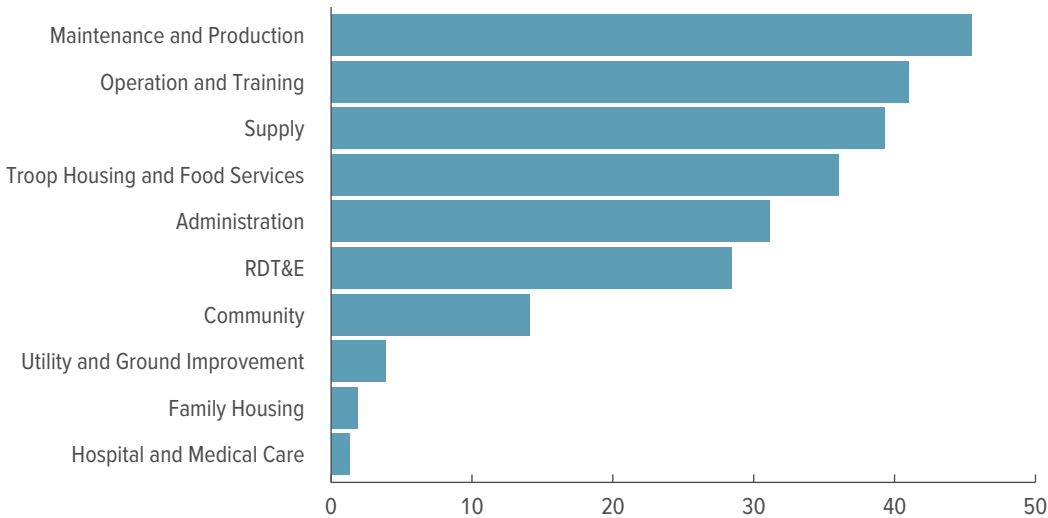
Functions of the Buildings Considered in CBO's Analysis

Using information on each building's predominant use, CBO grouped the buildings in its analysis into 10 categories based on the functions they served. Five of those categories—maintenance and production; supply; troop housing and food services; administration; and research, development, test, and evaluation (RDT&E)—generally support military units. Four categories—community, utility and ground improvement, family housing, and hospital and medical care—support the quality of life of people on base, and one category, operation and training, is most directly related to unit readiness.

Buildings in the maintenance and production, operation and training, and supply categories covered the largest amounts of space on the 59 bases CBO analyzed. (Buildings with a production function include those used to produce ammunition or assemble combat vehicles.)

Total Space Occupied by Navy Buildings, by Function

Millions of Square Feet



Buildings used for maintenance and production, operation and training, and supply accounted for more than half the space on the 59 bases CBO analyzed.

Basic Measures of Buildings' Performance

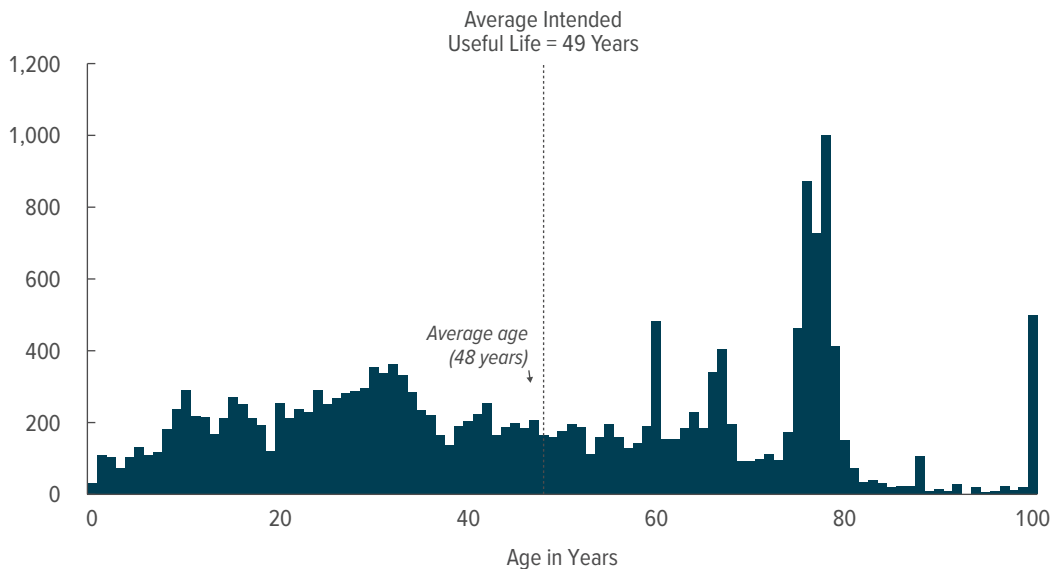
CBO used the Navy's data to determine how the age and physical condition of the buildings on Navy bases affected their maintenance costs and how well the buildings were configured to suit the missions of their users. Older buildings are typically costlier to maintain and may benefit from renovation more than newer ones would.² Buildings in poor physical condition also cost more to maintain and have diminished capability to support their users.

Age and Intended Useful Life

Of the 20,000 buildings that CBO identified, about 9,200 had surpassed their intended useful life and therefore had a book value of zero. As the Navy's buildings continue to age, an increasing portion of them will do so. That large and growing share of old buildings may have resulted from policies that prioritized funding for combat forces over funding for support areas such as infrastructure.

Distribution of Navy Buildings, by Age

Number of Buildings



Thousands of the Navy buildings CBO analyzed were 75 years old or older—the products of a wave of construction during the World War II era.

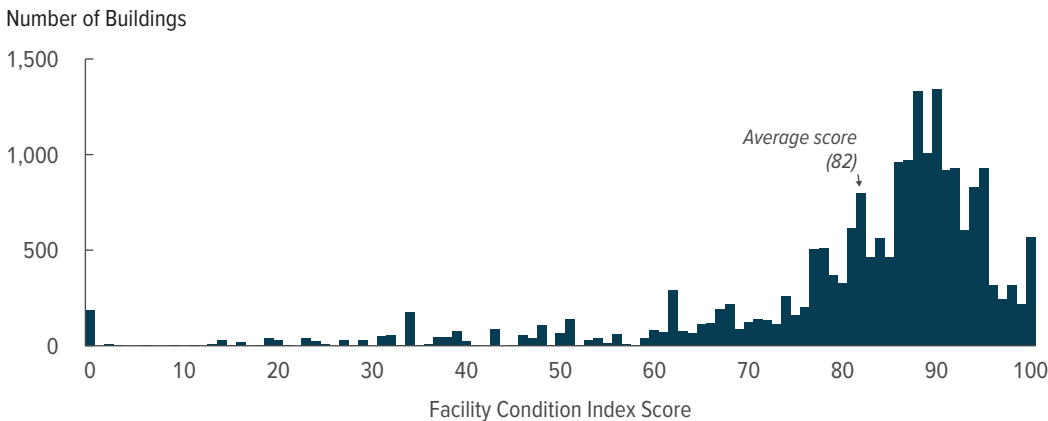
Physical Condition

The Navy uses two indexes to measure the physical condition of buildings. The **facility condition index (FCI)** reflects how the cost of a building's deferred maintenance compares with that building's replacement value. FCI scores range from zero to 100; the higher the score, the lower the relative deferred maintenance cost. For example, a score of 95 indicates that the cost of completing deferred maintenance would equal 5 percent of a building's replacement value. (See Appendix B for more information about the FCI.) The average FCI score for the buildings CBO analyzed was 82. Buildings used for family housing and for utilities and ground improvements had considerably lower average scores—66 and 61, respectively—indicating larger amounts of deferred maintenance.

The **condition index (CI)** reflects the condition of a building's physical components, such as its roof or electrical system. A score of 100 indicates that no components are in need of renovation or modernization; lower scores indicate the extent to which renovation and modernization would make the building fully functional. The average CI score of the buildings CBO analyzed was 74. However, the buildings used for hospital and medical care were in much worse condition, with an average CI score of 55.

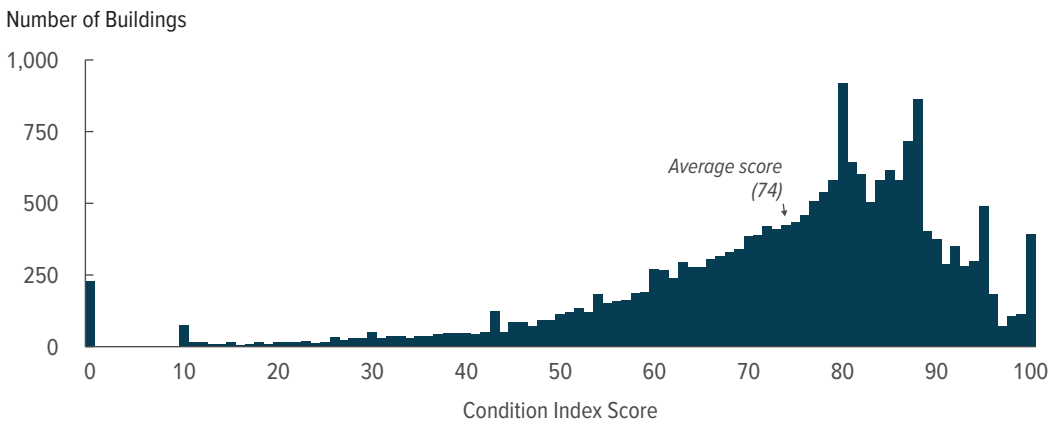
Buildings' CI scores were generally lower (that is, worse) than their FCI scores—perhaps because the CI captures degradation caused by factors other than uncompleted maintenance, such as aging. On average, for each decade of age, buildings' FCI scores were 1.6 points lower, whereas their CI scores were 2.3 points lower.

Distribution of Navy Buildings, by Facility Condition Index Score



The FCI scores of the buildings in CBO's analysis indicate that the cost of completing their maintenance is a fraction of their replacement value (18 percent, on average: 100 percent of the value minus the average FCI score of 82).

Distribution of Navy Buildings, by Condition Index Score



Low CI scores reflect major deficiencies that lead to greater estimated restoration and modernization costs.



Capability to Support Users' Missions

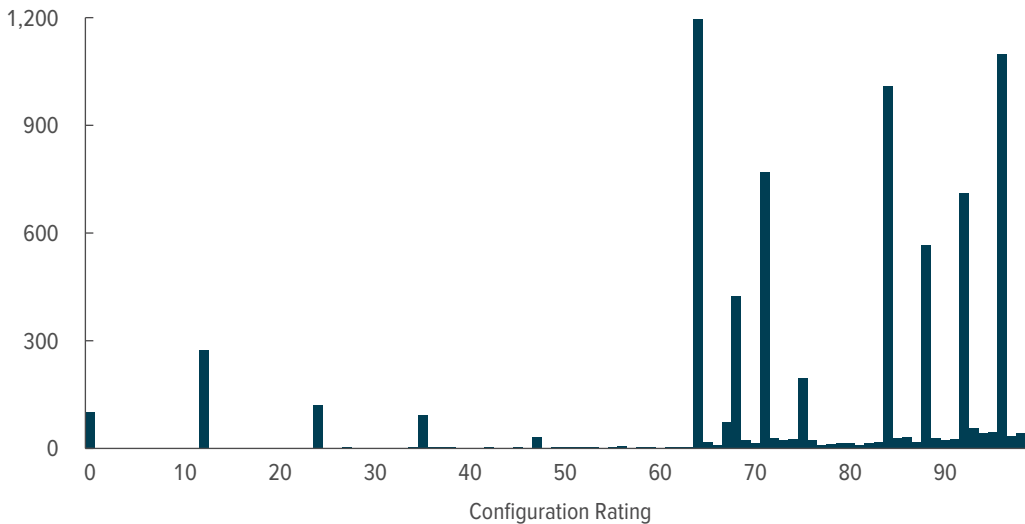
A building's **functional capability** is its overall ability to support the mission or function for which it is being used (not necessarily for which it was designed). A building's functional capability is affected not only by its physical condition—including decay in its structure or systems—but by its configuration, siting, and capacity. Mismatches between buildings' configurations and their occupants' missions can occur if Navy units or organizations change more rapidly than the buildings they use. The capabilities desired from certain types of buildings can also change over time, creating a demand for renovation and modernization even if the buildings' users are serving the same function.

The Navy measures the functional capability of its buildings using a **configuration rating (CR)**, which ranges from zero to 100 and reflects how well a building can support the missions of its users. A CR of 100 implies that a building can fully support its users' missions without renovation or modernization. Lower CRs may reflect factors unrelated to the physical condition of buildings: If units are resized or reorganized, for example, the buildings they occupy may not accommodate their new missions.

According to Navy officials, many buildings had not undergone configuration assessments, and temporary CRs of 100 had been recorded for those buildings. Sufficient information to determine which buildings with a CR of 100 had a valid rating was not available to CBO. For that reason, the agency excluded all buildings with CRs of 100 from its analysis of buildings' functional capability. The average CR of the approximately 7,400 remaining buildings was 75.

Distribution of Navy Buildings, by Configuration Rating

Number of Buildings



Most of the buildings that had undergone a configuration assessment were generally able to support their users' missions.

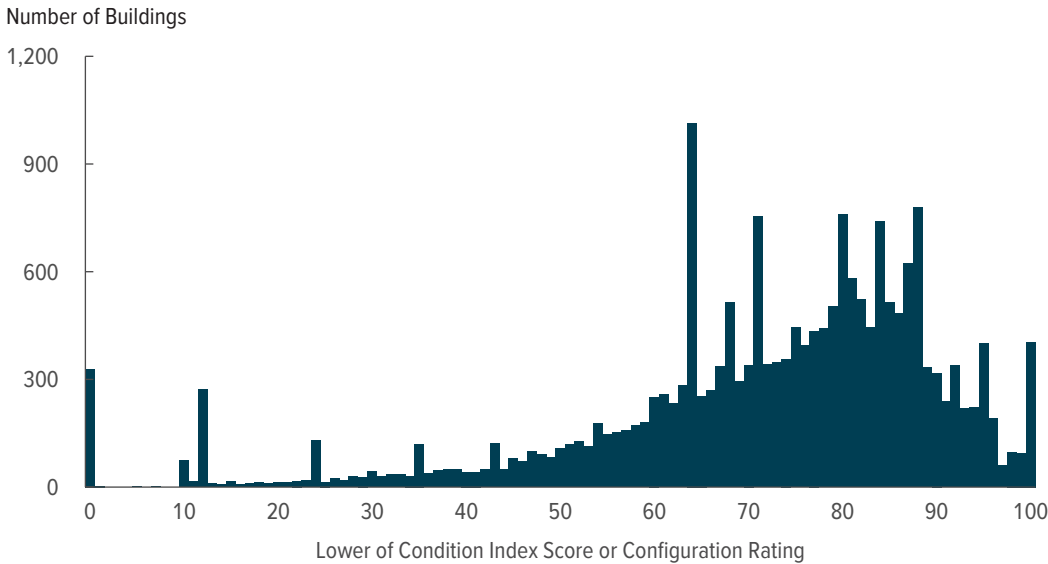


Overall Scope for Renovation and Modernization

Renovation restores a building to its original condition; modernization improves a building relative to its original condition (for instance, upgrading it to handle modern electrical loads). Certain tasks can accomplish both goals.

To account for the savings gained from performing such tasks concurrently, CBO used the lower (that is, the more adverse) of a building's CI score or CR to estimate its renovation and modernization costs. That approach incorporates the assumption that the total cost of a building's renovation and modernization would not be larger than the cost of the more expensive project if they were carried out concurrently. (For more details about how CBO estimated buildings' CI scores and CRs, see Appendix B.) For buildings with CRs of 100—those whose CRs the Navy considered uncertain—CBO used the CI score.

Distribution of Navy Buildings, by the Lower of Their Condition Index Score or Configuration Rating



Most of the 20,000 Navy buildings in CBO's analysis had ratings suggesting at least some scope for renovation or modernization. As of September 2020, the lower of buildings' CI score or CR averaged 71.

Costs of Eliminating the Navy's Deferred Maintenance Backlog

Using the Navy's data, CBO estimated the total cost of completing the service's maintenance to be \$17 billion as of 2020. By comparison, the active Navy spent about \$2.3 billion annually, on average, between 2020 and 2022 to sustain all of its real property, including buildings and nonbuilding structures.

The Navy and the other services use what is known as a facilities sustainment model to estimate annual amounts of funding that would sustain their inventory of real property over a normal life cycle. The model uses standard commercial cost factors, adjusted for quantity, location, and inflation, to estimate total maintenance and repair costs.³ In recent years, however, because of budget pressures, DoD has usually allowed the services to cover less than the full amount they estimate would sustain their real property. As a result, funding to sustain real property in the active Navy's budget ranged from 70 percent to 85 percent of the target levels estimated by the model between 2013 and 2022.

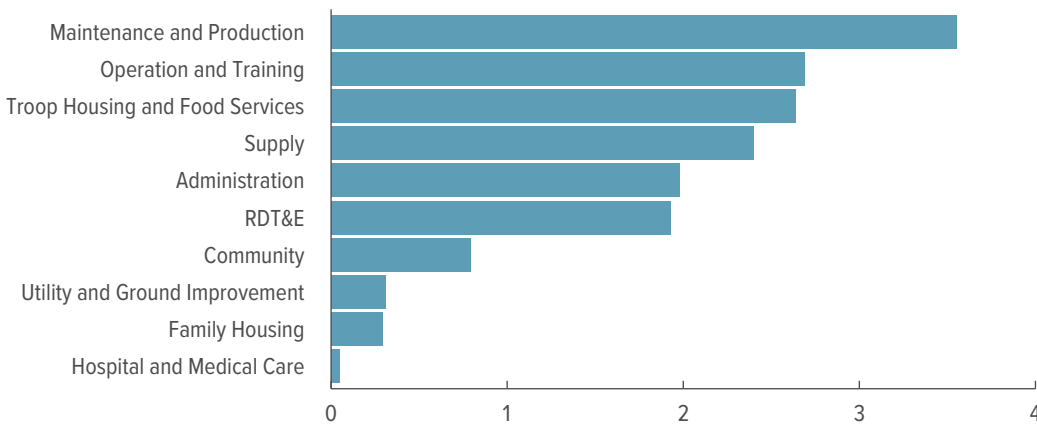
Costs of Deferred Maintenance, by Buildings' Function

In CBO's estimation, the categories of Navy buildings that covered the largest amounts of space had the largest deferred maintenance costs. The categories with more than \$2 billion in total deferred maintenance were maintenance and production, operation and training, troop housing and food services, and supply. Deferred maintenance costs per building were highest for the categories of troop housing and food services, administration, and maintenance and production: \$1.8 million, \$1.5 million, and \$1.4 million, respectively—all well above the average of \$0.8 million. (For estimates of costs per square foot, see Appendix C.)

Deferred maintenance costs were higher for those categories because the buildings were larger, on average, than buildings in other categories and were in worse condition. For example, the average size of the buildings used for troop housing and food services was 24,000 square feet, whereas the average size for all buildings was 12,000 square feet. Facility condition index scores for troop housing and food service buildings averaged 81, slightly lower than the average of 82 for all buildings.

Cost to Complete Deferred Maintenance for Navy Buildings, by Function

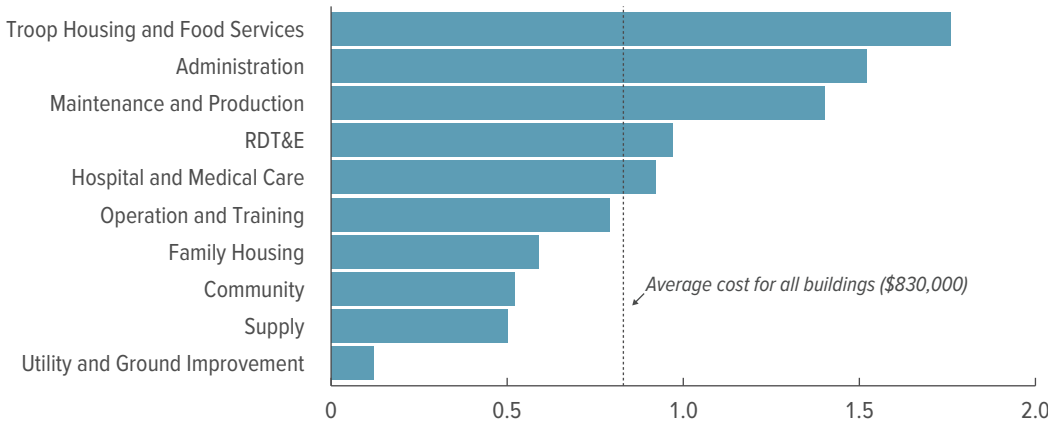
Billions of 2020 Dollars



The six categories of buildings with the largest deferred maintenance costs accounted for \$15 billion, or 91 percent, of the estimated \$17 billion cost to eliminate the Navy's deferred maintenance backlog.

Cost per Building to Complete Deferred Maintenance for Navy Buildings, by Function

Millions of 2020 Dollars



On a per-building basis, deferred maintenance costs were significantly larger in the categories of troop housing and food services, administration, and maintenance and production than they were in other categories.

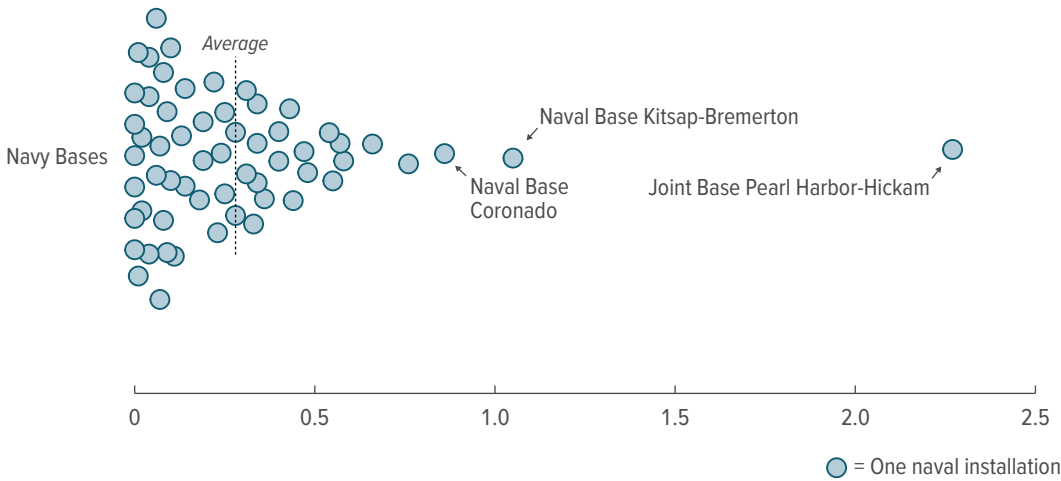
Costs of Deferred Maintenance, by Base

CBO also examined the distribution of deferred maintenance costs by base. The average deferred maintenance cost for all bases was \$280 million.

Joint Base Pearl Harbor-Hickam had the largest deferred maintenance cost, about \$2.3 billion. (Joint Base Pearl Harbor-Hickam includes Naval Station Pearl Harbor and Hickam Air Force Base.) That amount represents about 14 percent of the total deferred maintenance cost for all of the Navy buildings CBO analyzed.⁴ Naval Base Kitsap-Bremerton and Naval Base Coronado also had deferred maintenance costs that were significantly larger than the average costs for Navy bases. Those three bases have more square footage than the average Navy base.

Cost to Complete Deferred Maintenance for Navy Buildings, by Base

Billions of 2020 Dollars



Joint Base Pearl Harbor-Hickam, Naval Base Kitsap-Bremerton, and Naval Base Coronado had higher deferred maintenance costs than other Navy bases.



Costs of Renovating and Modernizing Buildings to Better Support Users' Missions

Like normal maintenance and repair, renovation and modernization projects can improve the condition of a degraded building, but they can also address discrepancies between the building's configuration and the missions of its users. Buildings that are better matched to their units' missions or can accommodate a wider variety of functions will benefit less from renovation and modernization.

In CBO's estimation, renovating and modernizing the active Navy's buildings to fully support the missions of their occupants would cost \$32 billion. By comparison, the active Navy spent roughly \$1.3 billion annually, on average, between 2020 and 2022 to renovate and modernize all of its real property, including nonbuilding structures.

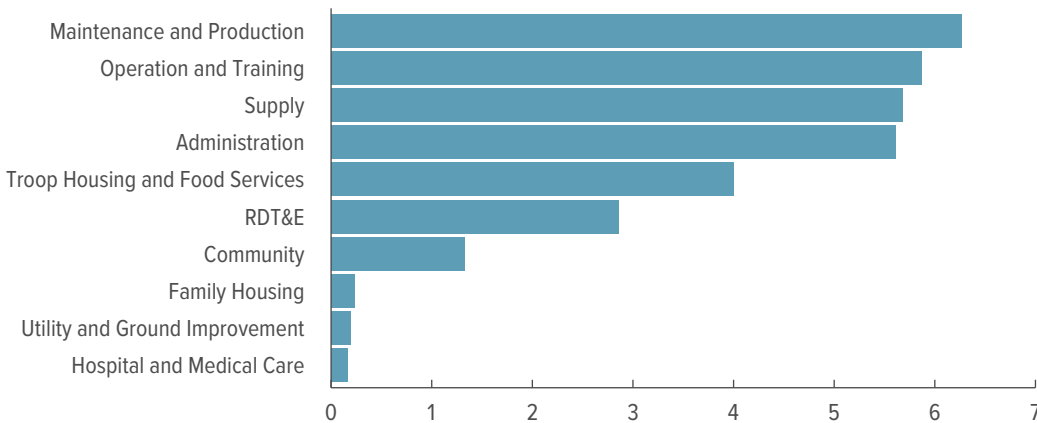
Costs of Renovating and Modernizing Buildings, by Function

Buildings in four categories—maintenance and production, operation and training, supply, and administration—had ratings suggesting that renovation and modernization would cost more than \$5 billion per category. Higher renovation and modernization costs generally indicate that buildings are larger, a poorer match for their users' missions, or both.

Costs per building were highest for the categories of administration, hospital and medical care, and troop housing and food services: \$4.3 million, \$2.8 million, and \$2.7 million, respectively—significantly larger than the \$1.6 million average for all buildings. (For estimates of costs per square foot, see Appendix C.) The renovation and modernization costs per building for operation and training, the category most directly related to unit readiness, was \$1.7 million.

Cost to Renovate and Modernize Navy Buildings, by Function

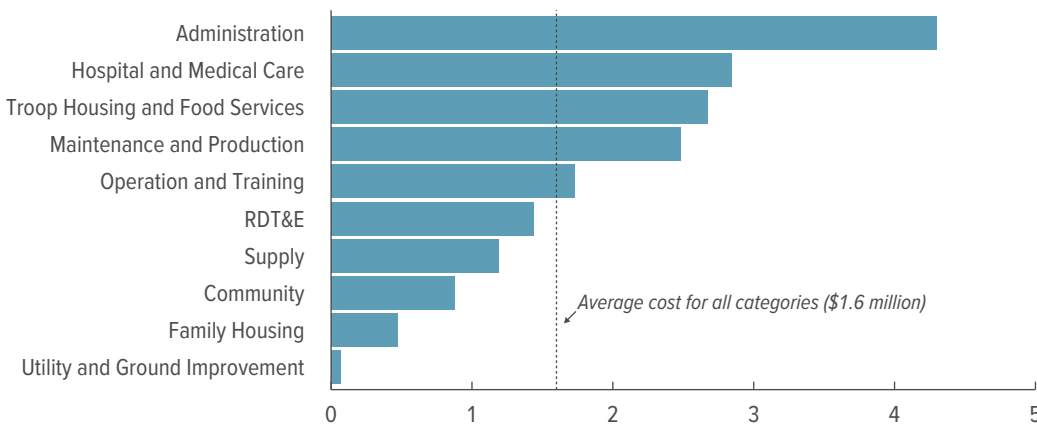
Billions of 2020 Dollars



Buildings in five categories accounted for about \$27 billion, or 87 percent, of the \$32 billion cost to renovate and modernize Navy buildings to fully match users' missions.

Cost per Building to Renovate and Modernize Navy Buildings, by Function

Millions of 2020 Dollars



Renovation and modernization costs per building were particularly large for administrative buildings and hospital and medical buildings.



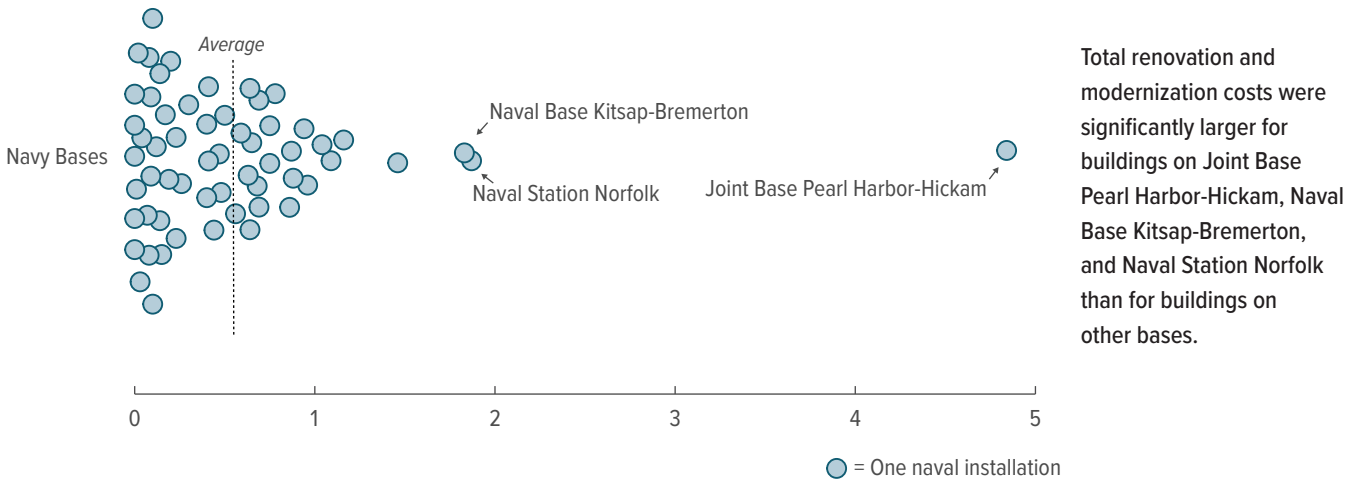
Costs of Renovating and Modernizing Buildings, by Base

In general, bases with high deferred maintenance costs also tended to have high renovation and modernization costs. Joint Base Pearl Harbor-Hickam had significantly larger renovation and modernization costs than other bases, about \$5 billion. That amount represented about 15 percent of the \$32 billion total cost of renovating and modernizing the Navy's buildings. Naval Base Kitsap-Bremerton and Naval Station Norfolk also had larger-than-average renovation and modernization costs.

Those bases accounted for a relatively large share of the Navy's building inventory. For example, of all the buildings in CBO's analysis, about 9 percent were located at Joint Base Pearl Harbor-Hickam, whereas the average for all bases was 2 percent.

Cost to Renovate and Modernize Navy Buildings, by Base

Billions of 2020 Dollars



Combined Costs of Deferred Maintenance and Renovation and Modernization

In CBO's estimation, eliminating the deferred maintenance backlog and renovating and modernizing the active Navy's buildings to fully support users' missions would cost roughly \$49 billion altogether—\$17 billion for deferred maintenance and \$32 billion for renovation and modernization. That amount represents more than 20 percent of the active Navy's total budget of \$220 billion for 2022.

Performing regular maintenance concurrently with work to renovate and modernize buildings should be more efficient, resulting in savings. However, CBO did not incorporate such savings into its estimates of the combined costs of deferred maintenance and of renovation and modernization because the information necessary to do so was not available. Therefore, the combined costs shown in this section represent an upper bound of the Navy's costs as of 2020.

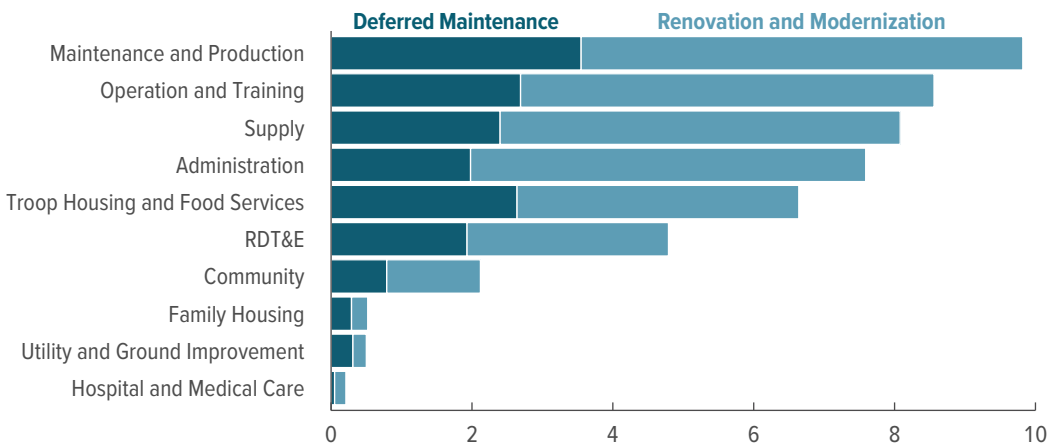
Combined Costs of Deferred Maintenance and Renovation and Modernization, by Buildings' Function

The combined costs of deferred maintenance and of renovation and modernization totaled \$8 billion or more for three categories of buildings: maintenance and production, operation and training, and supply.

The three categories with the largest costs per building—administration (\$5.8 million), troop housing and food services (\$4.4 million), and maintenance and production (\$3.9 million)—all served functions that support military units. (For estimates of costs per square foot, see Appendix C.) Buildings in those categories were bigger, on average, than buildings in other categories. The combined costs per building for operation and training, the category most directly related to unit readiness, were similar to the average for all buildings.

Combined Cost to Complete Deferred Maintenance and to Renovate and Modernize Navy Buildings, by Function

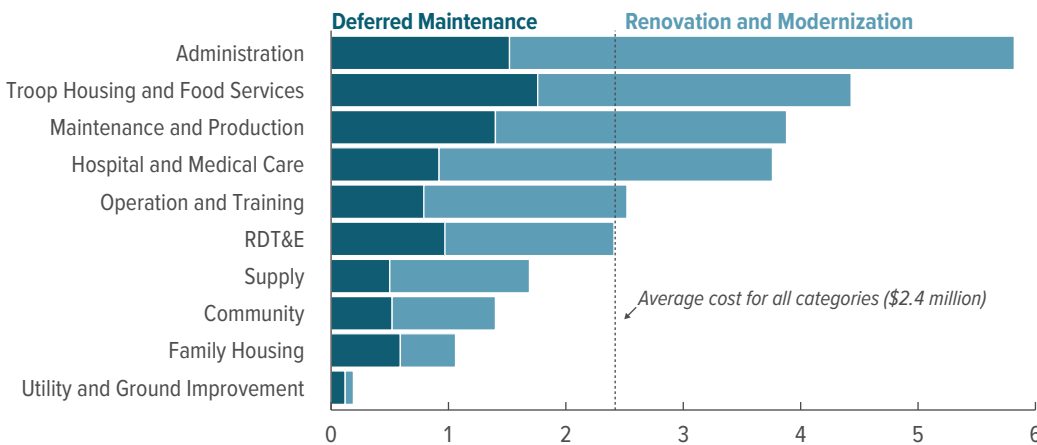
Billions of 2020 Dollars



Five of the 10 categories of buildings accounted for about \$41 billion, or 83 percent, of the \$49 billion combined cost to eliminate the deferred maintenance backlog and to renovate and modernize Navy buildings.

Combined Cost per Building to Complete Deferred Maintenance and to Renovate and Modernize Navy Buildings, by Function

Millions of 2020 Dollars



For four categories of buildings, the combined costs per building of deferred maintenance and of renovation and modernization were considerably larger than the average for all categories.

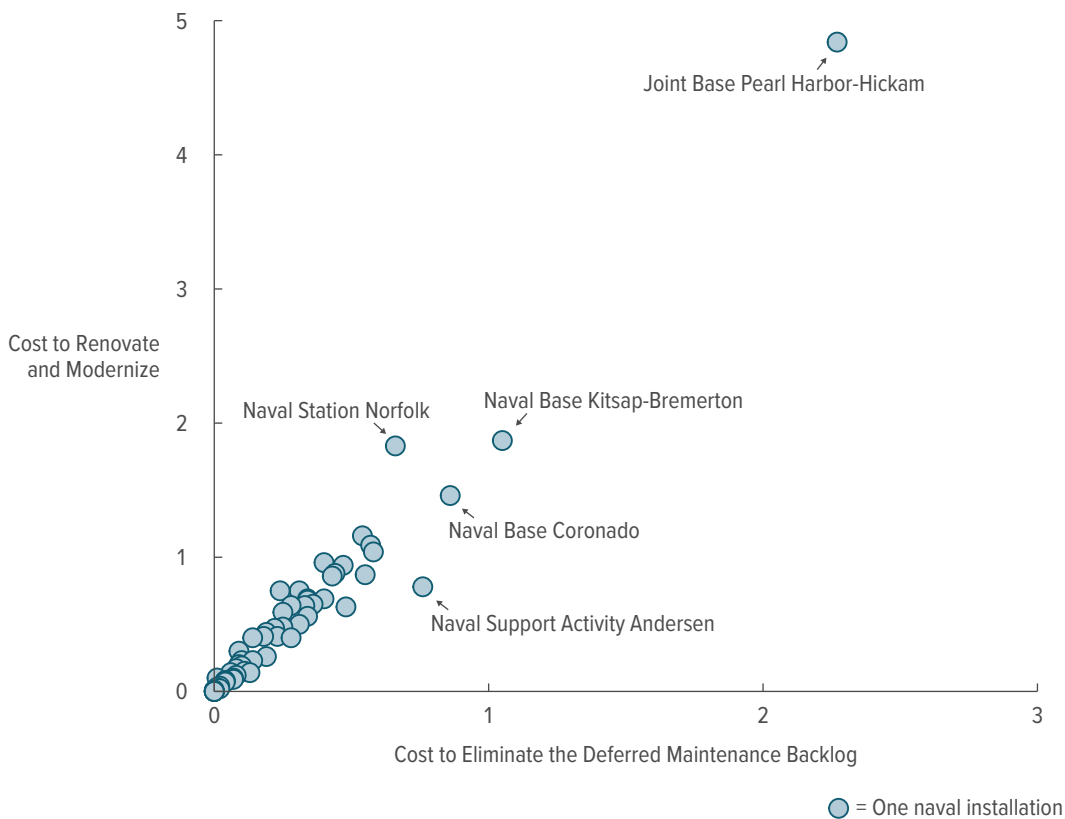


Costs of Deferred Maintenance in Relation to the Costs of Renovation and Modernization, by Base

For most bases, renovation and modernization costs exceeded deferred maintenance costs, but high costs of renovation and modernization were generally associated with high costs of deferred maintenance, and vice versa. The three bases with the largest combined costs were Joint Base Pearl Harbor-Hickam (\$7.1 billion), Naval Base Kitsap-Bremerton (\$2.9 billion), and Naval Station Norfolk (\$2.5 billion). Those costs represent about 26 percent of the total estimate of \$49 billion for the Navy.

Relationship Between the Cost to Complete Deferred Maintenance and the Cost to Renovate and Modernize Navy Buildings, by Base

Billions of 2020 Dollars



The Navy bases with high deferred maintenance costs also generally had high renovation and modernization costs. Joint Base Pearl Harbor-Hickam had the highest costs of both types.

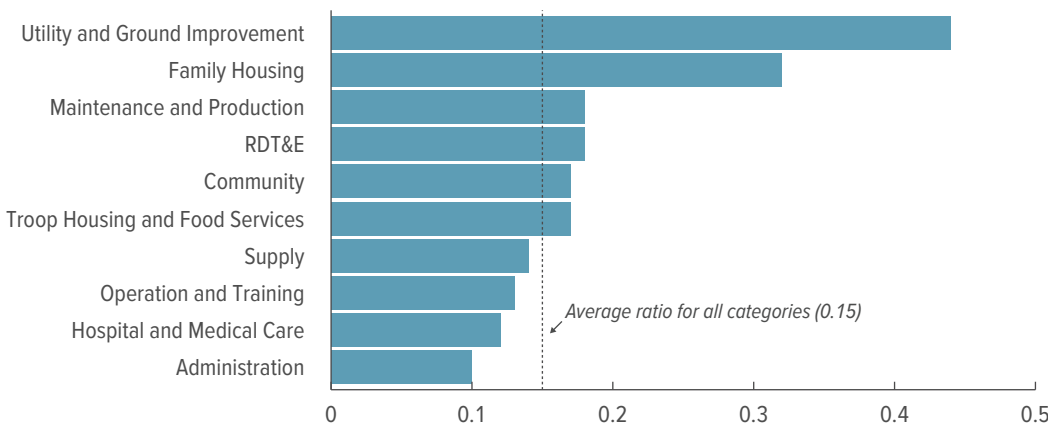
Costs Relative to Replacement Value

To compare the costs of deferred maintenance and of renovation and modernization with buildings' replacement values, CBO translated those costs and values into ratios. A new building would have a ratio of zero; a ratio of 1.0 indicates that the cost of completing a building's deferred maintenance or its renovation and modernization is equal to the cost of replacing it. If the ratio is high enough, it is probably more cost-effective to simply build a new building.

Costs of Deferred Maintenance Relative to Replacement Value

CBO found that the cost of eliminating the deferred maintenance backlog amounted to about 15 percent of the replacement value, on average, for all categories of buildings. Buildings with higher ratios of deferred maintenance costs to replacement value were in worse repair and had lower facility condition index scores. Such ratios were significantly higher for buildings used for utilities and ground improvements than for buildings in other categories. They were smallest for buildings used for administration.

Ratio of Deferred Maintenance Costs to Replacement Value per Building, by Function

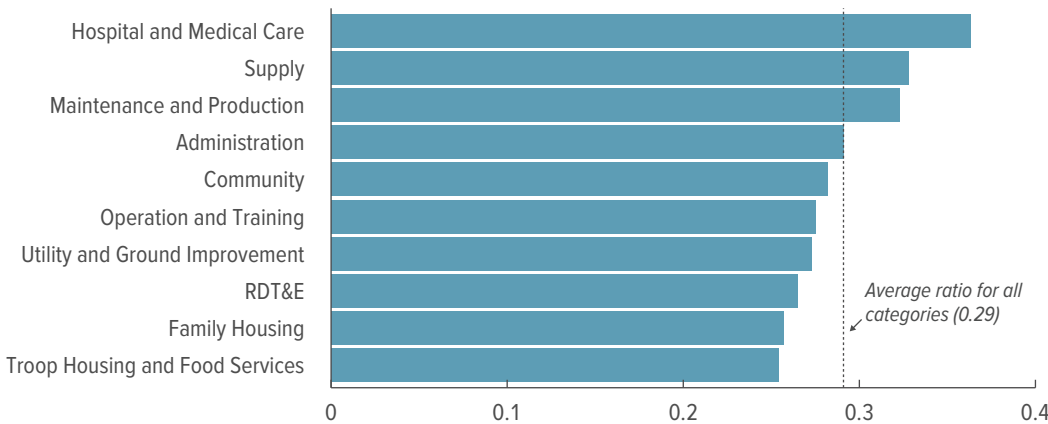


For buildings dedicated to utilities and ground improvements, the costs of deferred maintenance were, on average, equal to nearly one-half of the cost of constructing a new building.

Costs of Renovation and Modernization Relative to Replacement Value

For all the buildings in CBO's sample, the average ratio of renovation and modernization costs to replacement value was 0.29. (A ratio of 1.0 indicates that the costs of renovating and modernizing a building would equal the costs of constructing a new building for the same function.) That ratio was highest for buildings used for hospital and medical functions and lowest for buildings used for troop housing and food services.

Ratio of Renovation and Modernization Costs to Replacement Value per Building, by Function

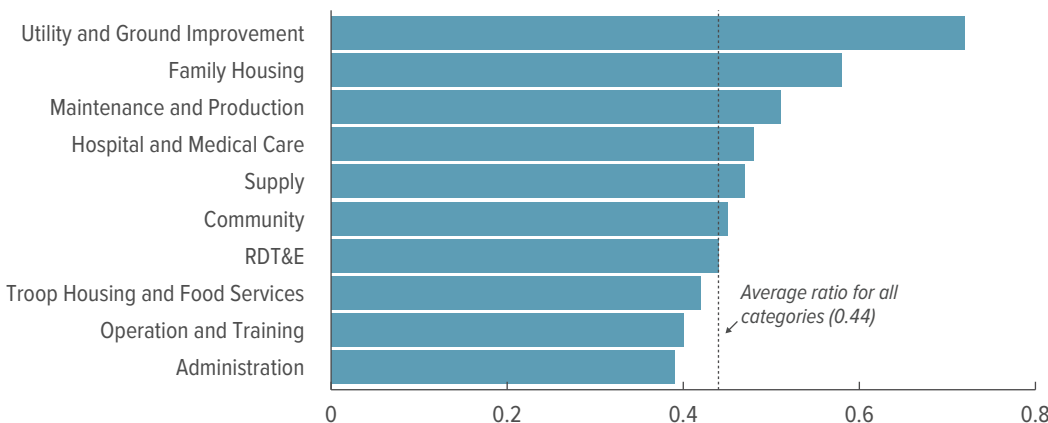


For buildings used for hospital and medical care, renovation and modernization costs were, on average, equal to 36 percent of the cost of constructing a new building.

Combined Costs of Deferred Maintenance and Renovation and Modernization Relative to Replacement Value

On average, the ratio of buildings' combined costs of deferred maintenance and of renovation and modernization to replacement value was 0.44. (A ratio of 1.0 indicates that those combined costs for an existing building would equal the costs of constructing a new building for the same function.) That ratio was highest for buildings used for utilities and ground improvements and was lowest for buildings used for administration.

Ratio of Combined Deferred Maintenance Costs and Renovation and Modernization Costs to Replacement Value per Building, by Function



For buildings dedicated to utilities and ground improvements, the combined costs of deferred maintenance and of renovation and modernization were, on average, almost three-fourths the cost of constructing a new building.



Uncertainty About Estimated and Future Costs

CBO's estimates of the costs of deferred maintenance and of renovation and modernization were current as of September 2020. Since then, the prices of goods and services have risen considerably in the United States, which means that those costs have probably increased as well—and may continue to rise. CBO attributes recent increases in prices in part to supply chain disruptions caused by the coronavirus pandemic, as well as high demand for goods and services in the U.S. economy. And CBO projects that, during the next few years, the price index for nonresidential structures, which includes the price of building materials, will be 30 percent to 40 percent higher than it was in 2020.

Although the Navy data that CBO used for this analysis were from 2020, the condition of most buildings was assessed at least one year earlier. CBO's estimates do not account for changes in the buildings' condition after assessment. They also do not account for the effects of ongoing programs to upgrade and modernize facilities in the Navy's public shipyards. (For details on one notable program, the Shipyard Infrastructure Optimization Program, see Appendix A.)

1. The active Navy and the Navy Reserve have separate budgets to operate and maintain their real properties, so it is appropriate to analyze those properties separately.
2. Previous research has shown that as Navy buildings age, their annual maintenance and repair costs rise, on average. See Glen H. Ackerman, Jino Choi, and Ty D. Weis, *The Backlog of Maintenance and Repair: Preventing Its Growth and Measuring Its Impact*, CRM 95-26 (Center for Naval Analyses, April 1995).
3. In 2013, DoD began transitioning to another model, the Sustainment Management System (SMS), to estimate its annual sustainment funding requirements. The SMS uses the results of on-site assessments of real property to forecast when major repairs or replacement would be appropriate for systems such as roofs, as well as the effects of delays in those corrective measures. For more details on the SMS, see Government Accountability Office, *Defense Infrastructure: DOD Should Better Manage Risks Posed by Deferred Facility Maintenance* (January 2022), GAO-22-104481, www.gao.gov/products/gao-22-104481.
4. In an earlier analysis of Army bases, CBO found that deferred maintenance costs were highest at bases in Hawaii. See Congressional Budget Office, *The Army's Costs to Eliminate Its Deferred Maintenance Backlog and to Renovate and Modernize Its Buildings* (November 2022), www.cbo.gov/publication/58220.

Appendix A: The Shipyard Infrastructure Optimization Program

The Navy's four public shipyards allow the service to perform critical maintenance on the nuclear and conventional ships in its fleet. But some real property assets in those shipyards, including machine shops, dry docks, and piers, have been in use for more than 200 years.¹ In particular, the buildings in those shipyards that serve maintenance and production functions tend to be older than other Navy buildings—averaging 59 years of age as of September 2020. They are also generally in worse physical condition.

Despite the shipyards' importance to the Navy's operational readiness, investments to sustain and modernize their facilities have historically fallen short of the Navy's stated goals. The active Navy funded about 80 percent, on average, of its annual benchmarks for sustainment from 2013 to 2022.

In 2018, the Navy began the Shipyard Infrastructure Optimization Program (SIOP) to improve the condition, capacity, and configuration of facilities in its public shipyards.² In its first and current stage, the program will focus on shipyards' infrastructure and industrial plant equipment, prioritizing the creation and maintenance of dry docks to support modern ship classes. The second stage of the SIOP will address the maintenance, renovation, and modernization of shipyards' facilities.

The Congress directed the Navy to allocate \$1.9 billion in 2023 from its military construction and operation and maintenance accounts to support the SIOP, including almost \$300 million for restoring and modernizing facilities. (Facilities include buildings, piers, dry docks, and capital equipment.) That \$300 million represents about 20 percent of the Navy's entire restoration and modernization budget for 2023. In 2024, the Navy plans to allocate an additional \$208 million (or 14 percent of its request for restoration and maintenance funds for 2024) for the restoration and modernization of facilities under the SIOP.³

The SIOP could increase the productivity of Navy shipyards and improve the readiness of Navy ships. But prioritizing funding for buildings in shipyards could further worsen the condition of the Navy's other buildings and increase the Navy's total costs of renovation and modernization in the future.

The estimated costs of deferred maintenance and of restoration and modernization in this report do not incorporate the potential effects of the SIOP on the condition of the Navy's buildings in the future. It remains unclear whether prioritizing restoration and modernization funds through the SIOP will improve or degrade the overall condition of the Navy's buildings.

1. Peter Lynch and others, Navy briefing to CBO staff on the Shipyard Infrastructure Optimization Program (March 21, 2023).

2. For more information on the SIOP, see Naval Sea Systems Command, "Building the Shipyards the Nation Needs" (accessed August 31, 2023), www.navsea.navy.mil/Home/Shipyards.

3. Department of the Navy, *Fiscal Year (FY) 2024 Budget Estimates: Justification of Estimates, Operation and Maintenance* (March 2023), <https://tinyurl.com/4cbwekdv>.

Appendix B: How CBO Estimated the Costs of Deferred Maintenance and of Renovation and Modernization

To estimate deferred maintenance costs, the Congressional Budget Office used a formula that relates a building's facility condition index (FCI) score to its replacement value. To estimate renovation and modernization costs, CBO used a formula that relates a building's condition index (CI) score or its configuration rating (CR), whichever is lower, to its replacement value.

Deferred Maintenance Costs

CBO's estimates of the Navy's deferred maintenance costs are based on the FCI, which expresses a building's maintenance and repair costs as the difference between 100 percent and the percentage of the building's replacement value, as shown in the following equation:

$$I = \left[1 - \left(\frac{dm}{V}\right)\right] * 100$$

where I is a building's FCI score, dm is its accumulated deferred maintenance, and V is its replacement value.

The costs of deferred maintenance were derived from that formula as follows:

$$dm = \left[1 - \left(\frac{I}{100}\right)\right] * V$$

To estimate the total costs of deferred maintenance for all buildings or a category of buildings, CBO summed the buildings' dm values.

Deferred maintenance costs are calculated for the Navy and for the entire Department of Defense using a system called BUILDER. Each year, the Navy downloads estimates of deferred maintenance costs for each building in its inventory directly from the BUILDER database. Those estimated costs are used to inform the development of future budgets. With the formula above, dm values can also be used to measure a building's physical condition.

The data provided to CBO by the Navy included FCI scores calculated from dm estimates. The most degraded buildings had FCI scores below zero. According to the Department of Defense, FCI scores should range from zero to 100. An FCI score lower than zero suggests degradation so severe that repairing a building to the Navy's standards would cost more than replacing it; as a result, buildings with large negative FCI scores are likely to be replaced rather than repaired. Total deferred maintenance costs for those buildings should not exceed their replacement value.

To estimate the Navy's total deferred maintenance cost, CBO imputed FCI scores of zero for buildings with negative scores (1 percent of the buildings in the sample).

Renovation and Modernization Costs

CBO used the lower (more adverse) of a building's CI score or CR to estimate its renovation and modernization costs. Respectively, those scores express the cost of renovating or modernizing a building to the Navy's standards as a percentage of that building's replacement value, as shown in the following equation:

$$I = \left[1 - \left(\frac{\max(r, m)}{V}\right)\right] * 100$$

where I is a building's CI score or CR, r is its renovation cost, m is its modernization cost, and V is its replacement value.

Renovation and modernization costs were derived from that formula as follows:

$$\max(r, m) = \left[1 - \left(\frac{I}{100}\right)\right] * V$$

To estimate total renovation and modernization costs for all buildings or categories of buildings, CBO summed the buildings' maximums of r and m .

Appendix C: Estimates of Deferred Maintenance and Renovation and Modernization Costs per Square Foot

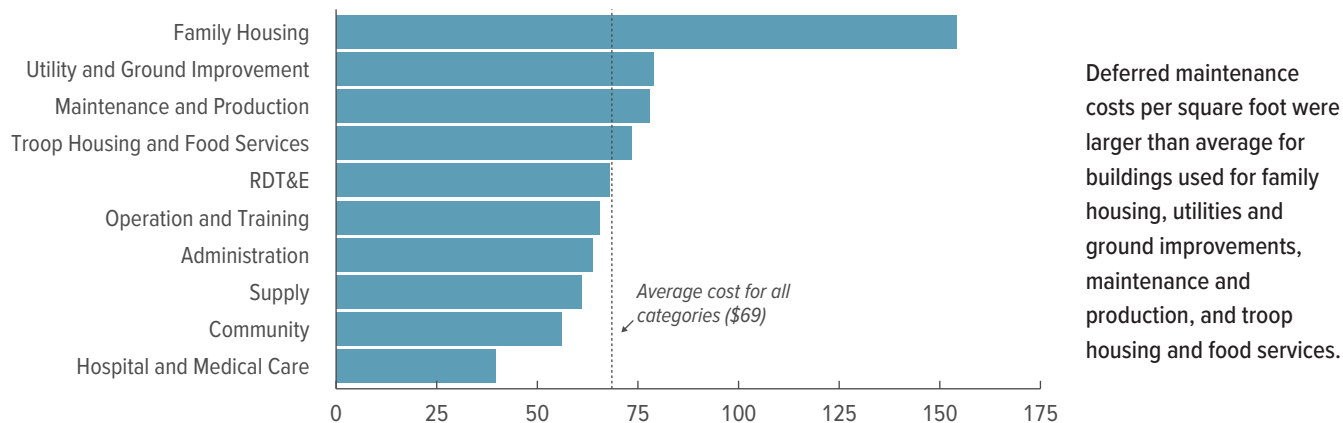
This report focuses on the costs of deferred maintenance and of renovation and modernization per building because buildings are visually recognizable as discrete units on military bases. However, it may also be helpful to think about buildings' costs of maintenance and of renovation and modernization per square foot. In the private sector, it is common for buildings to be evaluated and priced by their square footage.

The following figures illustrate the costs per square foot of deferred maintenance (see Figure C-1), renovation and modernization (see Figure C-2), and both deferred maintenance and renovation and modernization (see Figure C-3) for each category of buildings.

Figure C-1.

Cost per Square Foot to Complete Deferred Maintenance for Navy Buildings, by Function

2020 Dollars

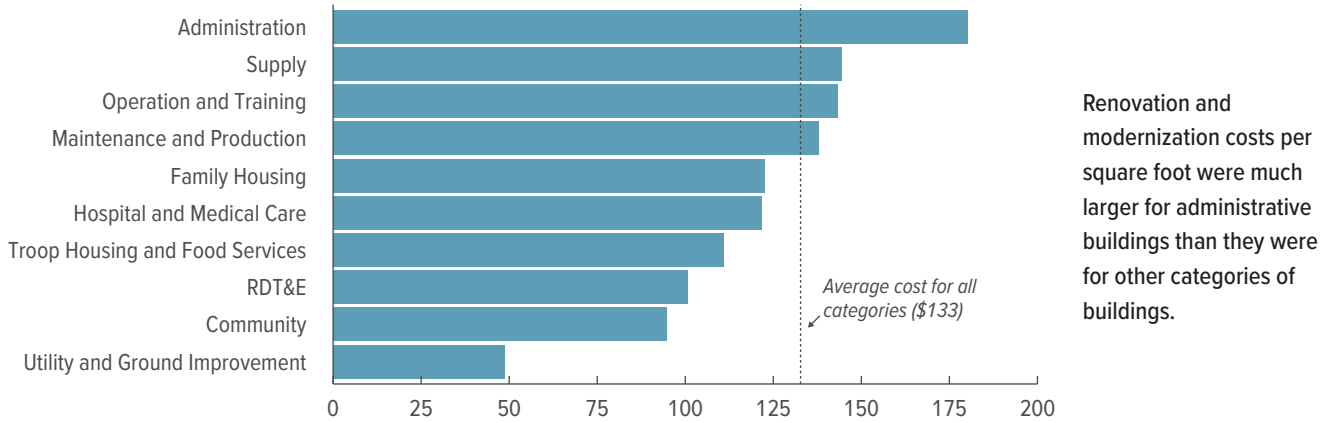


Data source: Congressional Budget Office. See www.cbo.gov/publication/59381#data.

Figure C-2.

Cost per Square Foot to Renovate and Modernize Navy Buildings, by Function

2020 Dollars



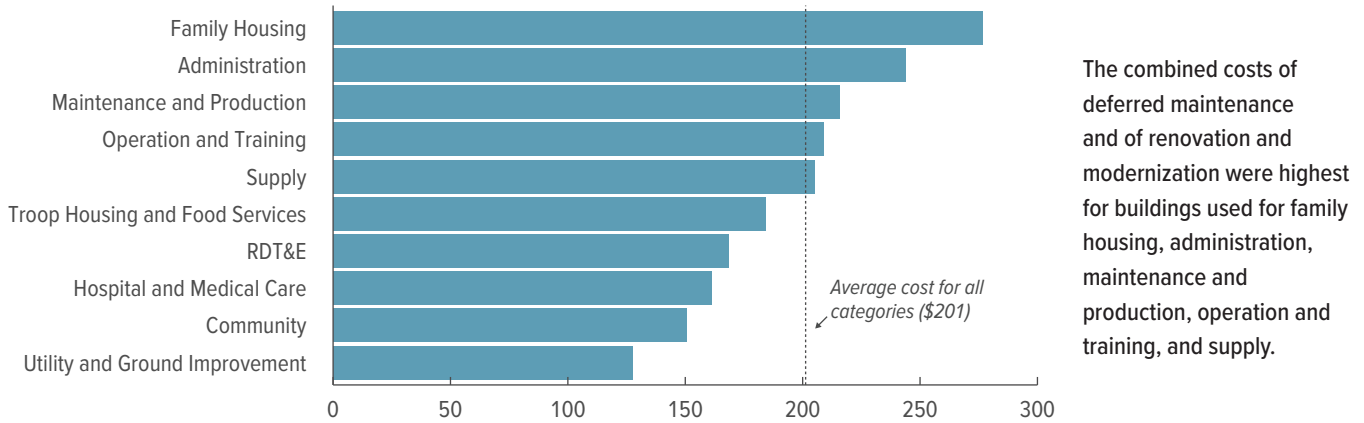
Renovation and modernization costs per square foot were much larger for administrative buildings than they were for other categories of buildings.

Data source: Congressional Budget Office. See www.cbo.gov/publication/59381#data.

Figure C-3.

Combined Cost per Square Foot to Complete Deferred Maintenance and to Renovate and Modernize Navy Buildings, by Function

2020 Dollars



The combined costs of deferred maintenance and of renovation and modernization were highest for buildings used for family housing, administration, maintenance and production, operation and training, and supply.

Data source: Congressional Budget Office. See www.cbo.gov/publication/59381#data.



About This Document

This report was prepared at the request of the Chairman and Ranking Member of the Subcommittee on Readiness of the House Armed Services Committee. In keeping with the Congressional Budget Office's mandate to provide objective, impartial analysis, the report makes no recommendations.

Adebayo Adedeji (formerly of CBO), Kathryn McGinnis (formerly of CBO), Edward G. Keating, and Nikhil Bhandarkar prepared the report with assistance from Xinzhe Cheng, Illiyuna Islam (formerly of CBO), and Chandler Lester and with guidance from David Mosher. R. Derek Trunkey fact-checked the report.

William Komiss of CNA and Andrew Tilghman of the Congressional Research Service provided expert insights. The assistance of external reviewers implies no responsibility for the final product; that responsibility rests solely with CBO.

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CBO seeks feedback to make its work as useful as possible. Please send comments to communications@cbo.gov.



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