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Projected Costs of U.S. Nuclear Forces, 2015 to 2024

Nuclear weapons have been a cornerstone of U.S. national security since they were developed during World War II. During the Cold War, nuclear forces were central to U.S. defense policy, resulting in the buildup of a large arsenal. Since that time, they have figured less prominently than conventional forces, and the United States has not built any new nuclear weapons or delivery systems for many years.

The current strategic nuclear forces—consisting of submarines that launch ballistic missiles (SSBNs), land-based intercontinental ballistic missiles (ICBMs), long-range bombers, and the nuclear weapons they carry—are reaching the end of their service lifetimes. Over the next two decades, the Congress will need to make decisions about the extent to which essentially all of the U.S. nuclear delivery systems and weapons will be modernized or replaced with new systems.

To help the Congress make those decisions, the National Defense Authorization Act of 2013 (Public Law 112-239) required the Congressional Budget Office (CBO) to estimate the 10-year costs of the Administration's plans to operate, maintain, and modernize U.S. nuclear forces. In response, CBO published *Projected Costs of U.S. Nuclear Forces, 2014 to 2023*.[1] The National Defense Authorization Act of 2015 (P.L. 113-291) requires CBO to periodically update its estimate of the cost of nuclear forces. This report constitutes the first such update.

CBO estimates that over the 2015–2024 period, the Administration's plans for nuclear forces would cost $348 billion, an average of about $35 billion a year, and an amount that is close to CBO's December 2013 estimate of $355 billion for the 2014–2023 period. (Both estimates are given in nominal dollars; that is, they include the effects of inflation.) Although the two estimates of total costs are similar, projected costs for nuclear programs of both the Department of Defense (DoD) and the Department of Energy (DOE) have changed. Over the next 10 years, CBO estimates, DoD's costs would total $227 billion, which is about $6 billion (or 3 percent) more than the 10-year estimate published in 2013, and DOE's would total $121 billion, which is about $13 billion (or 9 percent) less than CBO's 2013 estimate.

This report describes the major differences between the two sets of estimates. The cost projections have risen for some categories of expenses but have declined for others. One might expect the total to increase because the current estimate spans a 10-year period that begins and ends one year later than the estimate published in December 2013 (2015–2024, compared with 2014–2023 for the December 2013 estimate) and thus includes one later year of development in modernization programs (development costs typically increase, or ramp up, as a program proceeds). Nevertheless, budget-driven delays in several programs, including a three-year delay for the new cruise

1. Congressional Budget Office, *Projected Costs of U.S. Nuclear Forces, 2014 to 2023* (December 2013), www.cbo.gov/publication/44968.

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

missile and its nuclear warhead and longer delays in some programs for extending the useful lives of nuclear warheads, have reduced the costs projected for the next decade.

Basis of CBO's Updated Estimates

CBO's estimate includes the cost to field, operate, maintain, and modernize U.S. nuclear forces. This update was prepared using the same approach as the original estimate; it considers only those costs that CBO has identified as directly associated with the nuclear mission and projected over the 10-year period from 2015 to 2024. Unlike estimates by some other observers, CBO's estimate does not include a prorated share of the services' and DoD's overhead and support costs that are not specific to the nuclear mission.

For this update, CBO analyzed the 2015 budgets for DoD and DOE and their associated justification documents. (CBO's December 2013 estimate, covering the 2014–2023 period, was based on its analysis of the 2014 budgets and associated documents.) To produce 10-year estimates, CBO identified the budget lines that are relevant to nuclear forces and, by examining the long-range plans for each program, projected each one beyond the five-year window in the departments' documents. CBO estimated the costs for replacement systems that are expected to begin development within the 2015–2024 period but that are not yet fully reflected in the departments' budgets (specifically, the Long-Range Strike Bomber and the new cruise missile) by reviewing actual costs for analogous systems that have already been built and the schedules that would be required to maintain inventories as currently planned. Many of CBO's projections also drew on its analyses for other reports.[2] CBO used the planned 2019 levels of operation and maintenance activities and number of military personnel to project costs for subsequent years. In keeping with DoD's historical experience, CBO projects that costs for both categories will grow somewhat faster than inflation.

To comply with funding caps enacted in the Budget Control Act of 2011 (as modified by subsequent legislation), lawmakers may need to set funding at amounts below those planned by the Administration and projected in this report for 2016 through 2021 (the final year, under current law, in which caps are imposed on discretionary spending). CBO's estimate does not account for such differences. It also does not include any changes to the plans for nuclear forces that would result from initiatives that the Secretary of Defense announced in November 2014 to address issues raised in an independent review of DoD's nuclear enterprise.[3] Detailed budgets for those initiatives will not be available until the Administration submits its budget proposals for fiscal year 2016.

CBO has projected DoD's and DOE's budgets in four broad categories:

- DoD's budgets for strategic systems (the three types of systems that can deliver long-range nuclear weapons—SSBNs, ICBMs, and long-range bombers) and DOE's budgets for activities related to specific warheads used for strategic systems and for nuclear reactors that power SSBNs;
- DoD's budgets for tactical aircraft that can carry nuclear weapons over shorter ranges and DOE's budgets for activities related to the warheads they carry;
- Budgets for activities at DOE's nuclear weapons laboratories that are not attributed directly to a specific warhead type but that are related to maintaining current and future stockpiles of weapons; and
- Budgets for DoD's command, control, communications, and early-warning systems that allow operators to communicate with nuclear forces, issue commands that control their use, and detect or rule out incoming attacks.

Those program-by-program estimates reflect the assumption that DoD's and DOE's plans would be executed successfully and on budget—that is, the estimates do not incorporate any cost growth beyond the funding levels planned by DoD or DOE. However, because programs

2. Some cost projections, particularly for research and development and procurement, drew on analyses undertaken for Congressional Budget Office, *Long-Term Implications of the 2015 Future Years Defense Program* (November 2014), www.cbo.gov/publication/49483.

3. Chuck Hagel and Bob Work, "Reforms to the Nuclear Enterprise" (Department of Defense press briefing, November 14, 2014), http://go.usa.gov/tGWF; and Department of Defense, *Independent Review of the Department of Defense Nuclear Enterprise* (June 2014) http://go.usa.gov/tG8C (PDF, 2.7 MB).

often cost more than originally planned, CBO has also estimated cost growth beyond the projected budgeted amounts in the aggregate for the four cost categories, on the basis of historical experience with DoD's and DOE's programs.[4]

CBO's Projections of the Costs of U.S. Nuclear Forces, 2015–2024

Over the 2015–2024 period, the Administration's plans for nuclear forces would cost $348 billion, CBO estimates (see Table 1). Of that total, CBO projects that $299 billion would be budgeted by DoD and DOE as follows:

- $160 billion for strategic nuclear delivery systems and weapons;
- $8 billion for tactical nuclear delivery systems and weapons;
- $79 billion for nuclear weapons laboratories and their supporting activities; and
- $52 billion for nuclear-related command, control, communications, and early-warning systems.

The remaining $49 billion represents CBO's estimate of additional costs that would be incurred over the coming decade if the growth rates for the nuclear program's costs are similar to the average growth rates for similar programs in the past.

CBO estimates that the costs of nuclear forces represent roughly 5 percent to 6 percent of the total costs of the Administration's plans for national defense for the next 10 years.

The estimate of $348 billion for total costs of nuclear forces for the 2015–2024 period is just $7 billion less than CBO's December 2013 estimate of $355 billion for the 2014–2023 period. Although the two estimates are close, notable changes have occurred in both departments' nuclear programs, with the result that cost projections have increased in some areas but have declined in others. In particular, CBO estimates that DoD's costs would total $227 billion, $6 billion more than it estimated in 2013, and DOE's costs would total $121 billion, about $13 billion less than it estimated in 2013.

The costs CBO projects for DoD have risen because the projections cover a 10-year period that starts and ends one year later than the 2013 estimate. New programs thus are one year further along in the process of ramping up development, and some are entering production. (Thus, the estimate does not necessarily signal an increase in the programs' total lifetime costs.) That higher cost projection also reflects a change in the plans for modernizing the Minuteman III ICBMs. Those added costs would be partially offset by decreases in some support costs realized from DoD's plans to reduce headquarters staffing as part of a departmentwide effort to lower costs for command and control. A change in the plans for nuclear-related communications satellites also is expected to reduce 10-year costs.

The decrease in projected costs for DOE is primarily the result of its plans to postpone or reduce the scope of some weapon modernization programs and infrastructure construction projects. Some of those costs could still be incurred, but only after the end of the current 10-year projection period. Increased costs for some support activities are expected to partially offset the decrease in DOE's modernization costs.

In addition to the costs directly attributable to fielding nuclear forces, some published estimates of the cost of nuclear weapons account for the costs of several related activities. They may include, for example, the costs of addressing the nuclear legacy of the Cold War (including the costs to dismantle retired nuclear weapons and clean up environmental contamination from past activities at nuclear facilities); the costs of reducing the threat from other countries' nuclear weapons (including U.S. efforts to halt proliferation, comply with arms control treaties, and verify other countries' compliance with treaties); and the costs of developing and maintaining active defenses against nuclear weapons from other countries, primarily against ballistic missiles. CBO's estimate of those costs, published in 2013, has not been updated, and those costs are not addressed in this report.

4. For more detail on the nuclear programs and CBO's approach to estimating costs, see Congressional Budget Office, *Projected Costs of U.S. Nuclear Forces, 2014 to 2023* (December 2013), www.cbo.gov/publication/44968.

Table 1.

Projected Costs of U.S. Nuclear Forces, by Department and Function

Billions of Dollars

	2015			Total, 2015–2024		
Category	DoD	DOE	Total	DoD	DOE	Total
CBO's Projections of Budgeted Amounts for Nuclear Forces[a]						
Nuclear delivery systems and weapons						
Strategic systems						
Ballistic missile submarines	5.5	1.0	6.4	75	8	83
Intercontinental ballistic missiles	1.3	0.2	1.5	24	3	26
Bombers	2.0	0.5	2.5	32	7	40
Other nuclear activities[b]	1.0	n.a.	1.0	11	n.a.	11
Subtotal	9.8	1.7	11.4	142	18	160
Tactical delivery systems and weapons	0.4	0.4	0.7	4	3	8
Nuclear weapons laboratories and supporting activities						
Stockpile services	n.a.	1.1	1.1	n.a.	15	15
Facilities and infrastructure	n.a.	2.1	2.1	n.a.	28	28
Other stewardship and support activities[c]	n.a.	3.4	3.4	n.a.	37	37
Subtotal	n.a.	6.5	6.5	n.a.	79	79
Total, Nuclear Delivery Systems and Weapons	**10.1**	**8.5**	**18.7**	**146**	**101**	**247**
Command, control, communications, and early-warning systems						
Command and control	1.2	n.a.	1.2	12	n.a.	12
Communications	2.1	n.a.	2.1	20	n.a.	20
Early warning	1.9	n.a.	1.9	19	n.a.	19
Subtotal	5.2	n.a.	5.2	52	n.a.	52
Total Budgeted Amounts for Nuclear Forces	**15.4**	**8.5**	**23.9**	**198**	**101**	**299**
Estimated Additional Costs Based on Historical Cost Growth	n.a.	n.a.	n.a.	28	21	49
Total Estimated Cost of Nuclear Forces	**15.4**	**8.5**	**23.9**	**227**	**121**	**348**

Source: Congressional Budget Office based on information from the Department of Defense and the Department of Energy.

Note: DoD = Department of Defense; DOE = Department of Energy; n.a. = not applicable.

a. This category is based on CBO's analysis of DoD's and DOE's budget proposals and accompanying documents as well as CBO's projections of those budget figures under the assumption that programs will proceed as described in budget documentation. The category also includes several programs for which plans are still being formulated. In those cases, CBO based its estimate on historical costs of analogous programs. The budgeted amounts do not reflect independent estimates by CBO of the costs of U.S. nuclear forces.

b. This category includes nuclear-related research and operations support activities by DoD that CBO could not associate with a specific type of delivery system or weapon.

c. Activities include security forces, transportation of nuclear materials and weapons, and scientific research and high-performance computing to improve understanding of nuclear explosions. This category also includes $400 million in 2015 and $4 billion over the 2015–2024 period for federal salaries and expenses. (This category of costs had previously been referred to as Office of the Administrator of the National Nuclear Security Administration.)

Categories With the Largest Changes in Costs

CBO projects higher budgeted amounts over the 2015–2024 period than it projected for the 2014–2023 period for nuclear delivery systems and weapons as well as for weapons laboratories and supporting activities. But it projects lower budgeted amounts for command, control, communications, and early-warning systems and less overall cost growth.

Nuclear Delivery Systems and Weapons

By CBO's estimate, the amounts budgeted for strategic nuclear delivery systems and weapons over 10 years under DoD's and DOE's plans would be about $4 billion more than CBO estimated in 2013, mostly because plans have changed somewhat in the 2015 budget for all three segments of the strategic nuclear triad of SSBNs, ICBMs, and bombers.

SSBNs. CBO projects that budgeted amounts for ballistic missile submarines would total $83 billion over 10 years, about $1 billion more than its 2013 estimate (see Table 2). Most of that sum would be for DoD's SSBN programs, which are projected to cost $75 billion, about $4 billion more than the 2013 estimate. The increase is primarily because the program for developing the new SSBN is shifting from the design phase and into production. In 2024, the final year of the 10-year period, the first new submarine is expected to be in its third year of construction, and the second new submarine is slated for procurement.

According to CBO's current projections, DOE's share of the amounts budgeted for SSBNs would be $8 billion, $3 billion less than CBO estimated in 2013. That decrease is mostly the result of a five-year delay in the planned development of the first interoperable warhead, or IW-1, which would be a single warhead design that is compatible either with submarine-based or with ground-based ballistic missiles. (In CBO's analysis, the cost of interoperable warheads is split evenly between SSBNs and ICBMs.) Other factors also contribute to the decline in DOE's share of the projected budgeted amounts for SSBNs. The department will spend less for the SSBNs' nuclear power reactors (primarily because the design of the new submarine's reactor will be completed before 2024); modifications to extend the useful life of the W76 warhead are expected to be completed in 2019; and the department has decided to delay development of the IW-2, the second interoperable warhead.

ICBMs. CBO projects that the amounts budgeted for ICBMs over 10 years would total $26 billion, nearly $3 billion more than its 2013 estimate. Of that, DoD's share would be $24 billion, $4 billion more than CBO estimated in 2013. However, the most recent estimate comes with substantial uncertainty about DoD's plans. The department plans to operate the current Minuteman III ICBM through 2030. Although it is considering several options for fulfilling the ICBM's mission after 2030—such as refurbishing existing missiles, developing a new missile, or both—its plans are not final.

In formulating its estimate in 2013, CBO assumed that DoD would design a new ICBM to replace the Minuteman III and that development would begin in 2018. However, in the 2015 budget, DoD indicated that it intends to replace the engines and guidance systems in the Minuteman III and that development for both efforts will begin in 2015. For this current estimate, CBO assumes that development of a new ICBM (if pursued) would not begin in earnest until after the refurbishment of the existing missiles is complete. Although those actions could reduce DoD's costs over the next several decades, CBO projects that over the 2015–2024 period, budgeted amounts would be somewhat higher than it anticipated in 2013 because refurbishing the existing missiles would start sooner and budgets would grow more rapidly in the short term than would occur with development of a new ICBM.

According to CBO's current projections, DOE's share of the amounts budgeted for ICBMs would be nearly $3 billion, about $1 billion less than CBO estimated in 2013. The primary reason for that decrease is the delay in beginning development of IW-1.

Bombers. Under the Administration's plans, CBO projects, the amounts budgeted for bombers over 10 years would be $40 billion, roughly the same as it estimated in 2013. Of that amount, DoD's share would be $32 billion, $3 billion more than it estimated in 2013.[5] The increase is attributable mostly to the planned ramp up

5. Bombers are used both for nuclear and for conventional missions. In its cost estimates, CBO has attributed 25 percent of the costs for the B-52 and Long-Range Strike Bomber to the nuclear mission and 75 percent to the conventional mission. In contrast, CBO attributed 100 percent of the costs of the B-2 bomber and nuclear-capable cruise missiles to the nuclear mission.

Table 2.

Differences in 10-Year Costs for Categories With the Largest Changes Between the 2015–2024 and 2014–2023 Estimates

Billions of Dollars

	Difference in 10-Year Total[a]		
Category	DoD	DOE	Total
CBO's Projections of Budgeted Amounts for Nuclear Forces[b]			
Nuclear delivery systems and weapons			
Ballistic missile submarines	4	-3	1
Intercontinental ballistic missiles	4	-1	3
Bombers	3	-3	0
Nuclear weapons laboratories and supporting activities	n.a.	2	2
Command, control, communications, and early-warning systems	-4	n.a.	-4
Estimated Additional Costs Based on Historical Cost Growth	-2	-8	-10
Total, Categories With Largest Changes	**5**	**-13**	**-8**
Memorandum:			
Total Across All Categories[c]	6	-13	-7

Source: Congressional Budget Office based on information from the Department of Defense and the Department of Energy.

Note: DoD = Department of Defense; DOE = Department of Energy; n.a. = not applicable.

a. The difference is calculated as the 2015–2024 estimate in this report minus the 2014–2023 estimate made in December 2013, so a positive amount reflects an increase in the more recent estimate.

b. This category is based on CBO's analysis of DoD's and DOE's budget proposals and accompanying documents as well as CBO's projections of those budget figures under the assumption that programs will proceed as described in budget documentation. The category also includes several programs for which plans are still being formulated. In those cases, CBO based its estimate on historical costs of analogous programs. The budgeted amounts do not reflect independent estimates by CBO of the costs of U.S. nuclear forces.

c. This category includes contributions from all categories shown in Table 1, including those categories with differences of less than $1 billion between the 2014 estimate and the 2013 estimate.

in development and production of the Long-Range Strike Bomber (initial fielding is scheduled for the mid-2020s). A budget-driven three-year delay in developing the Long-Range Standoff (LRSO) weapon—a new nuclear-capable cruise missile to replace the current Air-Launched Cruise Missile—is expected to reduce 10-year costs, partially offsetting the increase in the projected cost of the bombers.

CBO estimates that DOE's portion of the budgeted amounts for the bombers would amount to $7 billion, $3 billion less than it estimated in 2013. The difference is derived from changes in DOE's plans for the LRSO's warhead, which now call for delaying production by three years and stretching the development program by three years, and, as a result, would reduce the 10-year budgeted amounts. Both DoD and DOE have indicated that, with additional funding, development and production of the LRSO and its warhead could be accelerated, however.

In addition to changing the schedule, DOE has updated the parameters it uses to estimate the costs of future programs for extending the service lives of nuclear warheads. (Estimates for current programs have not changed substantially.) For example, DOE now estimates a substantially lower lifetime cost to develop and produce the cruise missile warhead (as outlined in its Stockpile Stewardship Management Plan, or SSMP). For that weapon, the estimated cost under the 2015 SSMP is $6.8 billion (with a range of $5.9 billion to $7.6 billion); the estimate in the 2014 SSMP was $11.5 billion (with no range specified). Some effects of the change in DOE's cost estimates would occur after the 10-year window that CBO used for its budget projections.

Nuclear Weapons Laboratories and Supporting Activities

CBO projects that under DOE's plans, the budgeted amounts for that agency's nuclear weapons laboratories and supporting activities over 10 years would be

$79 billion, $2 billion more than its 2013 estimate. Among the main contributors to the increase are the need for continuing design and preparation to build the department's Uranium Processing Facility; an increase in production of nuclear materials, process certification, and safety support as laboratories prepare for new life extension efforts for some weapons; and an emphasis on catching up on deferred maintenance at some facilities.

Command, Control, Communications, and Early-Warning Systems

CBO projects that the amounts budgeted for DoD's nuclear command, control, communications, and early-warning systems over 10 years would be $52 billion, about $4 billion less than its 2013 estimate. About $1 billion of that decrease falls under the command and control subcategory largely because of a planned reduction in operating costs for headquarters activities at Strategic Command and Global Strike Command (in keeping with a departmentwide effort to reduce costs). However, like the nuclear delivery systems and weapons, many nuclear command and control systems are aging and may need to be modernized. One source of uncertainty in CBO's estimates is the potential for new modernization activities that are not yet reflected in DoD's budget, which could increase costs over the projection period.

CBO's estimate of the budgeted amounts for nuclear-related communications also has shrunk, accounting for more than $2 billion of the reduction. The largest contributor is a new concept for the Advanced Extremely High Frequency communications satellite program. DoD now plans to forgo procuring satellites of the current design in favor of developing two new smaller satellites to fulfill the mission. The new plan would reduce costs over the next 10 years, according to DoD, although the extent to which it would affect long-term costs is not yet known. The projected budgeted amounts for early-warning systems also have declined somewhat.

Additional Costs Based on Historical Cost Growth

CBO projects that cost growth beyond its estimates of budgeted amounts would total $49 billion over the next 10 years, $10 billion less than its 2013 estimate. Growth in DoD's costs would amount to $28 billion, $2 billion less than CBO estimated in 2013. In general, most cost growth occurs when new systems are in development and early in production. Over the next 10 years, DoD would continue to develop and produce several new systems, including a ballistic missile submarine and a bomber, and such programs historically have experienced cost growth. With more development and production expected to occur in the 2015–2024 period than was projected for the 2014–2023 period, cost growth in those programs is expected to be higher in the later period. However, CBO's overall estimate of cost growth for DoD has declined slightly because CBO now projects smaller pay increases for military and civilian personnel than it projected last year, which more than offset the increase in estimated cost growth in development programs.[6]

Cost growth in DOE's program accounts for $21 billion of the total, $8 billion less than CBO estimated in 2013. DOE has either deferred or lengthened the development periods for life extension programs for two warheads so that most of the costs would be incurred after the end of the 10-year period covered by this report. The effect of that schedule change is a reduction in cost growth projected for DOE over the next 10 years, although some might occur later.

6. For information about CBO's new projection of pay for military and civilian personnel, see Congressional Budget Office, *Long-Term Implications of the 2015 Future Years Defense Program* (November 2014), www.cbo.gov/publication/49483.

This Congressional Budget Office (CBO) report was prepared as required by the National Defense Authorization Act for 2015. In keeping with CBO's mandate to provide objective, impartial analysis, this report makes no recommendations.

Michael Bennett of CBO's National Security Division prepared the report with guidance from David Mosher and Matthew Goldberg. Raymond Hall of the Budget Analysis Division contributed to the analysis with guidance from Sarah Jennings.

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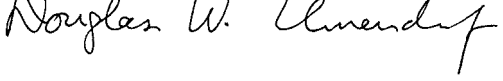

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