

TWO BIRDS WITH ONE STONE: HALTING U.S. NUCLEAR  
MODERNIZATION AND SOLVING CLIMATE CHANGE BY  
REPURPOSING THE NATIONAL SECURITY  
LABORATORIES

by

ALEXANDER ERWIG

A THESIS


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## **An Abstract of the Thesis of**

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Climate Change by Repurposing the National Security Laboratories

Approved:   
Jane K. Cramer

This thesis analyzes the national security laboratories under the leadership of the National Nuclear Security Administration and explores their role in U.S. nuclear modernization, finding that five of the eight labs could easily be repurposed to focus on the problem of climate change. The thesis begins by showing that U.S. spending on nuclear modernization is not only extremely wasteful, but also dangerous as it pressures other countries to pursue nuclear modernizations, thereby reversing the current trajectory of disarmament and starting a new arms race. Cutting many of these programs would save almost 300 billion dollars without affecting the United States' ability to deter nuclear aggression. This thesis demonstrates that repurposing these savings and the national laboratories could more than triple funding for climate change research. Three labs would be more than sufficient to maintain the U.S. nuclear deterrent for decades to come, which would allow the remaining five labs to utilize all of their resources to address climate change. The thesis finds that by shifting the mission of the laboratories, the labs would benefit the U.S. and the world by pursuing climate change research while halting the dangerous trajectory of nuclear modernization.

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## Introduction

“The survival of the United States of America as we know it is at risk. And even more — if more should be required — the future of human civilization is at stake,” Al Gore said to an audience in Washington D.C. in 2008.<sup>1</sup> He was referring not to terrorism or large-scale war, but to climate change. Climate change represents one of the greatest threats to the international community today, and has only increased in severity in the past several years. Without substantial new investments in climate change technologies, the effects of climate change will progress unchecked and cause significant damage both to the United States and to the rest of the world. The major challenge faced by climate change research currently is a lack of funding that hinders corporate and government research alike. Ideally, instead of coming from raising taxes, funding for research to address climate change could be secured by trimming already wasteful expenditures. An ideal place for these funds to come from is the funding currently allotted to the United States’ nuclear arsenal. The current arsenal is at the end of its planned life-cycle and the U.S. is gearing up for a full replacement of its Cold War nuclear triad by investing in new nuclear bombers, intercontinental ballistic missiles, submarines, and warheads. These planned modernizations include extensive unnecessary and wasteful expenditures that could easily be repurposed for climate change. Additionally, nuclear modernization programs are dangerous to international stability. As other nations see upgrades to the U.S. nuclear arsenal occurring, they are pressured to upgrade and replace their own arsenals, leading to a new nuclear arms race.

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<sup>1</sup> NPR Speech Transcript, Al Gore’s Speech on Renewable Energy, 2008.

For the U.S. arsenal, there are two options for the nuclear stockpile with very different consequences. Nuclear modernization is the process of not only rebuilding our current deterrent force, but also making the new force much more accurate, and with smaller warheads. To other countries, such as Russia and China, this looks like the U.S. is newly preparing for nuclear war-fighting, and not simply replacing its deterrent force. By contrast, Life Extension Programs, seek to keep the existing nuclear arsenal reliable and secure by replacing components and repairing defects. Although nuclear modernization is discussed as simply making the U.S. arsenal “safe and more reliable”, it is clearly also an active attempt to change the makeup of the nuclear arsenal by adding either entirely new warheads or creating new launch platforms for those warheads. Not only is the process of nuclear modernization far more expensive than life extension, but it also prompts other countries to pursue nuclear modernizations in order to keep up with the changes in the United States’ arsenal. In the Cold War, the Soviet Union responded to numerical increases in the U.S. arsenal by increasing the size of its own arsenal because it perceived the changes in the United States’ arsenal as threatening. Although the United States is no longer building up numerically, modernization prompts a technological arms race in much the same way as a numerical build-up did in the Cold War. As other countries see the U.S. arsenal gaining new capabilities, other nations are clearly being compelled to upgrade their own arsenals with similar increased capabilities or even increase their number of weapons in order to counter the perceived threat of modernization.

This thesis aims to demonstrate that the nuclear modernization programs of the United States are not only wasteful and expensive, but also foster international arms

rating that harms U.S. national security. Existing nuclear arsenals are more than sufficient to ensure that no nation will attempt a first strike with nuclear weapons, because even the existence of a single submarine ensures that unacceptable damage can be inflicted on an aggressor. In this thesis, I will first outline in detail the nuclear modernization programs being pursued by the United States and examine whether these programs are necessary for U.S. national security. Second, I demonstrate that the push for modernization is forcing other nations to spend vast resources on their own nuclear arsenals and increasing the likelihood of an accidental launch and nuclear conflict. Third, I show that the modernization initiatives impede the success of disarmament efforts and the viability of treaties regulating nuclear arsenals, threatening to unravel the progress that has been made in drawing down nuclear arsenals since the end of the Cold War.

Fourth, I analyze the eight national security laboratories in the United States that are part of the National Nuclear Security Administration's Nuclear Weapons Complex and isolate their individual roles and interests in the continued modernization of the nuclear arsenal. Fifth, I argue that almost all of the funds planned to be used in modernization should be reallocated to climate change research where they could have a massive impact on one of the greatest threats facing the world, thus killing two birds with one stone. Halting most of the proposed nuclear modernization programs in the United States would free up the planned \$271 billion over the next decade that could then be utilized for climate change research. This sum would be more than 23 times the \$11.6 billion the United States spent on all climate change related issues in 2014.<sup>2</sup>

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<sup>2</sup> U.S. Government Accountability Office. This sum includes "technology to reduce emissions, science to better understand climate change, and international assistance for developing nations".



Finally, I conclude by arguing that this shift of the labs towards climate change research would enable the United States to reverse the dangerous international trend towards modernized nuclear arsenals while simultaneously encouraging global investment in solutions to climate change.

## United States Nuclear Modernization

Politicians, military generals, and third-party analysts have repeatedly reaffirmed that nuclear weapons are usable only to punish an aggressor, and cannot be used to take territory from another nation. Because a nation with nuclear weapons always has the capability to completely destroy a nation that initiates a nuclear strike, there is no winning a nuclear war because both sides are annihilated. In the words of General Colin Powell, whose work with nuclear weapons spans multiple decades, “The one thing I convinced myself after all these years of exposure to the use of nuclear weapons is that they were useless. They could not be used.”<sup>3</sup> Even President Ronald Reagan, whose administration expanded the military budget by 43% and revived the B-1 Bomber Program, realized that “A nuclear war cannot be won and must never be fought. The only value in ... possessing nuclear weapons is to make sure they will never be used.”<sup>4</sup> Given the existence of nuclear weapons, each nation’s objective should be to make nuclear conflict less likely and reduce the total number of nuclear weapons in existence. Treaties like New START and the Nuclear Non-Proliferation Treaty have codified arms-reduction as a necessary step to securing a peaceful world, reflecting an international consensus about the function of these weapons. In order to be secure against potential nuclear aggression, a nation merely needs to maintain a secure second-strike force that can inflict unacceptable damage against the aggressor. This does not require a massive arsenal of thousands of warheads. Numerous strategists have found that even after an all-out nuclear attack, an arsenal with only several hundred warheads is more than enough to ensure that any attacking nation would suffer unacceptable

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<sup>3</sup> Introduction to Nuclear Tipping Point.

<sup>4</sup> Ronald Reagan’s 1984 State of the Union Address.

losses in that each weapon could destroy a city, and no country could survive losing hundreds of cities. This is why most nuclear powers maintain an arsenal of around 200 warheads; more warheads are simply irrelevant and serve no additional purpose.

Although there is no longer a numerical nuclear arms race, U.S. nuclear modernization programs have prompted major nuclear powers to invest massive sums in more advanced nuclear weapons. While these weapons do nothing to actually change the landscape of nuclear deterrence, they do serve to halt the existing push towards arms control and reductions in nuclear arsenals. Modernization programs are not confined to a single nation and have even involved non-nuclear states in deployment patterns for nuclear-armed states. Importantly, while modernization by the United States prompts modernizations in other countries, these modernization programs do nothing to change the overall balance of nuclear deterrence. Regardless of how sleek or precise nuclear weapons become, even the most modernized arsenal cannot successfully neutralize another nation's nuclear arsenal without that nation receiving unacceptable damage from a retaliatory strike. Just one nuclear submarine can carry around 200 warheads, and because these submarines are undetectable and constantly in motion, they serve as an unassailable deterrent. This means that nuclear modernization does not actually grant a nation the capability to conduct a first strike or change the balance of deterrence. However, nuclear modernization does prompt other nations to pursue similar modernizations because they perceive increased nuclear capabilities as necessitating a response. Matching the perceived capabilities of the United States becomes the objective, even though a fully modernized U.S. arsenal does not pose a threat to

deterrence. While modernization does not change the balance of the nuclear world, it does significantly affect the balances of each nation's budget.

The push for nuclear modernization is an expensive one, estimated to cost the United States at least 355 billion dollars over the next decade, with total costs potentially rising to over one trillion dollars over the next 30 years.<sup>5</sup> While some spending is necessary to maintaining the safety and security of the existing nuclear arsenal, the current nuclear funding plan has increasingly drawn criticism for being excessive and serving no purpose for the national security of the United States. Life Extension Programs for the existing arsenal are estimated to cost around \$2.5 billion per year, but modernization efforts will add at least \$30 billion each year.<sup>6</sup> Rather than pursuing cost-effective maintenance of current nuclear warheads and delivery systems, each branch of the U.S. military is modernizing and adding new capabilities to its arsenal. The 2011 Budget Control Act requires a minimum of \$115 billion in defense cuts between fiscal years 2016 and 2019.<sup>7</sup> The requirements set forth by this act have already prompted Congress to delay many of the proposed nuclear renovations and modifications until at least 2020 in order to meet near-term agreed spending reductions. While delaying expenses may be a convenient approach to alleviate the strain on the defense budget in the near future, it does not represent a long-term solution to the problems caused by exorbitantly expensive nuclear modernization programs.<sup>8</sup> Rather than simply delay programs and worry about funding allocations at a later date, a far more prudent strategy is to realistically examine what components of the nuclear

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<sup>5</sup> Tom Z. Collina, "The Unaffordable Arsenal: Reducing the Costs of the Bloated U.S. Nuclear Stockpile," *Arms Control Association* (2014): 2.

<sup>6</sup> Collina, "The Unaffordable Arsenal," 3.

<sup>7</sup> Tom Z. Collina, "White House Reviewing Nuclear Budget," *Arms Control Today* 44 (2014).

<sup>8</sup> Kingston Reif, "STRATCOM Shifts on Nuclear Costs," *Arms Control Today* 45 (2015).

program are necessary for U.S. national security and determine whether funding can be deployed in more efficient ways.

## Projected Budgets for Operating, Sustaining, and Modernizing the Strategic Nuclear Triad

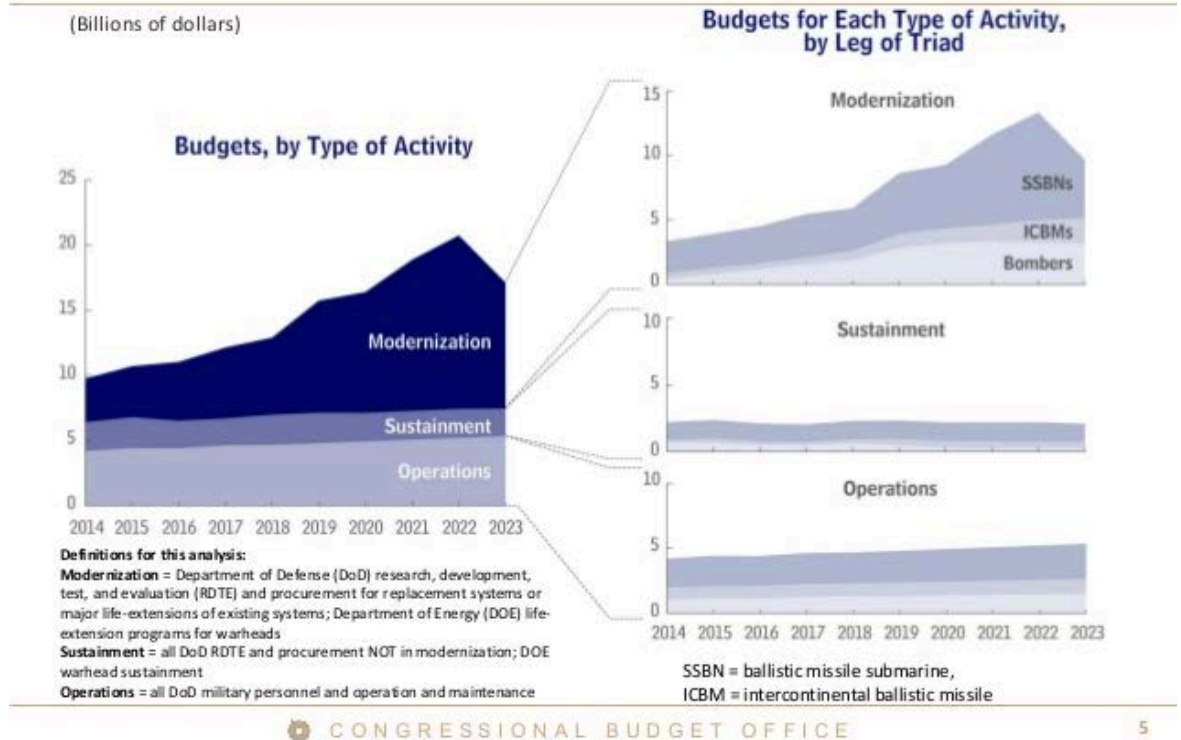


Figure 1: Projected budget for the nuclear triad 2014-2023<sup>9</sup>

### The Triad

The United States maintains a three-part nuclear arsenal consisting of bombers, submarines, and land-based missiles. During the Cold War nuclear planners argued that each of the components of the triad was necessary in order to ensure the survivability of the U.S. nuclear arsenal in the event of a Soviet first strike. The entire nuclear arsenal today contains approximately 1,600 warheads deployed across the three parts of the

<sup>9</sup> Congressional Budget Office, “Projected Costs of U.S. Nuclear Forces, 2014 to 2023” (2013): 10.

triad, with the New START Treaty dictating a further reduction to 1,550 warheads by 2018.<sup>10</sup> Responsibility for the nuclear arsenal is divided between the Air Force, the Navy, and the National Nuclear Security Administration. The Air Force deals with land-based missiles and bombers, the Navy with submarines and submarine-launched ballistic missiles, and the NNSA handles warhead maintenance and production.<sup>11</sup> I will proceed to examine the existing modernizations of each component of the nuclear arsenal and determine possible savings from cuts to these modernizations.

### *Bombers*

The Air Force currently maintains 159 nuclear-capable bombers, although this number is slated to be reduced to 60 by 2018. The planned force in 2018 will include B-2 and B-52 bombers and is estimated to be able to continue operating until at least 2040.<sup>12</sup> While this bomber fleet is still an active component of the U.S. nuclear triad it is not kept on high alert nor always equipped with nuclear weapons. Even as the relative importance of bombers in the nuclear triad is set to shrink, the Air Force is proposing the development of a new Long Range Strike Bomber (LRSB) currently set to be produced starting in the early 2020s. This bomber would have the ability to fulfill both conventional missions as well as launch nuclear weapons, but essentially represents no upgrade to the existing bomber fleet. Existing bombers are just as capable of deploying the weaponry that the LRSB is being designed to use. The total cost of just future

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<sup>10</sup> Collina, "The Unaffordable Arsenal," 2.

<sup>11</sup> Collina, "The Unaffordable Arsenal," 2.

<sup>12</sup> Collina, "The Unaffordable Arsenal," 10-11.

research and development on the LRSB is estimated to be at least \$25 billion, with production costs adding a minimum of \$55 billion for a total of \$80 billion.

The development proposal for the LRSB runs counter to existing recommendations from the Office of Management and Budget, which found that “as a result of ongoing efforts to upgrade the existing bomber fleet with new electronic and weapons systems, current aircraft will be able to meet the threats expected in the foreseeable future.”<sup>13</sup> Maintaining existing bomber forces and extending their operational capability would save \$80 billion without undermining the Air Force’s capability to provide a credible second strike response force against potential aggressors. The New START Treaty has as its goal the reduction of the total number of nuclear bombers. Currently, the Air Force plans to keep only 60 B-2 and B-52 bombers operational through 2040, which would represent a commitment to the treaty’s call for smaller bomber forces. With the production of the LRSB, however, the Air Force would add an additional 80-100 bombers to the nuclear bomber fleet.<sup>14</sup> Even if all 60 B-2 and B-52s were phased out, the addition of the LSRBs would mean that the entire U.S. bomber fleet would see an increase in size and thus run counter to New START. Because the new bomber is unnecessary, expensive, and violates a treaty designed to reduce bomber forces, this program should be cut to save \$80 billion.

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<sup>13</sup> Office of Management and Budget, “Terminations, Reductions, and Savings: FY2010 U.S. Budget,” (2009): 44.

<sup>14</sup> Collina, “The Unaffordable Arsenal,” 8.

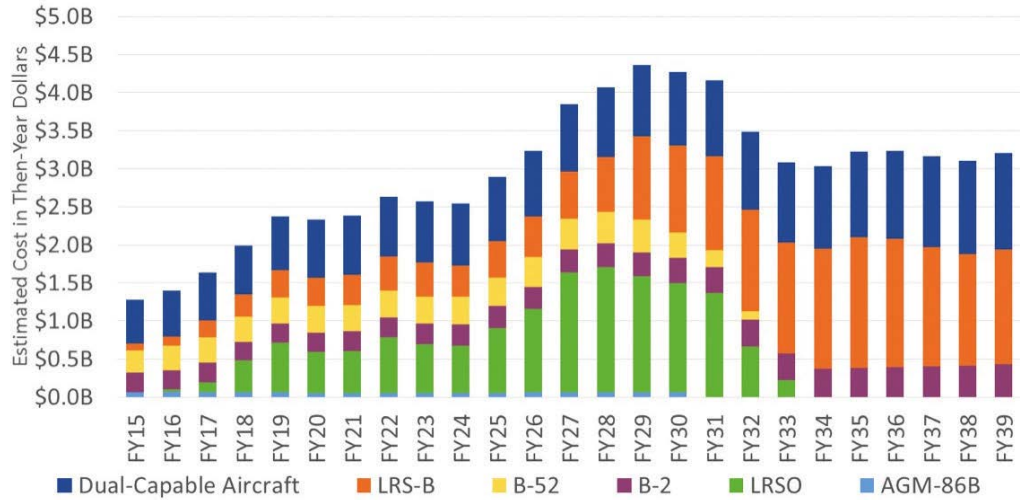


Figure 2: Estimated Nuclear-related costs of Bomber developments<sup>15</sup>

Additionally, the Air Force has also pushed for the development of entirely new Air Launched Cruise Missiles (ALCMs) for nuclear warheads at an estimated cost of \$20 billion. The current ALCM maintained by the Air Force, the AGM-86B, has been kept operable through life extension programs (LEPs) far longer than the initial expected lifetime of ten years.<sup>16</sup> In 2010, the Defense Department stated that it would soon evaluate whether or not to continue life-extension programs for ALCMs, develop a new ALCM, or cancel the program altogether.<sup>17</sup> The function of ALCMs is to allow bombers to fire nuclear or conventional weapons at targets without having to penetrate air defenses. While air-defense penetration was highly important in the Cold War to bolster NATO against the Soviet Union in Europe, developments in missile technology and U.S. conventional superiority have made this an obsolete consideration.<sup>18</sup>

<sup>15</sup> Todd Harrison and Evan B. Montgomery, “The Cost of U.S. Nuclear Forces: From BCA to Bow Wave and Beyond,” *Center for Strategic and Budgetary Assessments* (2015): 16.

<sup>16</sup> Collina, “The Unaffordable Arsenal,” 11-12.

<sup>17</sup> William J. Perry and Andy Weber, “Mr. President, kill the new cruise missile,” *The Washington Post* (2015).

<sup>18</sup> Perry and Weber, “Mr. President”.



In the event of a nuclear conflagration it would make no difference whether bombers dropped their payloads on their targets from above or shot them from a distance using cruise missiles. Because ALCMs can contain either conventional or nuclear warheads, they have a high potential to lead to accidental launches and miscalculations from other nuclear powers.<sup>19</sup> Because any launched cruise missile could potentially constitute a nuclear attack the very existence of ALCMs fosters an international climate of fear that only serves to heighten tensions and increase the probability of an accidental nuclear launch. Currently, the only nations to deploy ALCMs are the U.S., Russia, and France, but other nuclear powers are on the path to developing nuclear-tipped cruise missiles as well.<sup>20</sup> Rather than modernize its ALCMs and continue to risk miscalculation, the United States could do away with its existing ALCM force in order to secure a global ban on these weapons, and thereby also save a minimum of \$20 billion.<sup>21</sup>

Neither a bomber upgrade nor a new cruise missile should be pursued by the United States. Cutting both of these technologies would save at least \$100 billion without any negative impact on national security. Existing bomber forces are perfectly capable of fulfilling the same functions that the LSRB would be purposed for and cruise missiles are an unnecessary technology that only serves to increase the risk of miscalculation. Pursuing life extension programs for the B-2 and B-52 bombers ensures a stable bomber-based leg of the triad at a fraction of the cost of the new bomber and cruise missile.

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<sup>19</sup> Perry and Weber, "Mr. President".

<sup>20</sup> Perry and Weber, "Mr. President".

<sup>21</sup> Collina, "The Unaffordable Arsenal," 12.

## *Intercontinental Ballistic Missiles*

The current ICBM force consists of 450 Minuteman III missiles located at three Air Force bases: F.E. Warren Air Force Base in Wyoming, Malstrom Air Force Base in Montana, and Minot Air Force Base in North Dakota.<sup>22</sup> The Minuteman III missiles were deployed in the 1970s, and have been reliably maintained for more than 40 years through LEPs without any indication of instability or malfunction. Despite the effectiveness of the LEP for the Minuteman III, the Air Force is currently considering the development of an entirely new modernized missile that would serve as a replacement for the Minuteman III. This new missile represents an unnecessary investment with substantial financial and security repercussions. The cost of building an entirely new silo-based missile is estimated by a 2014 RAND study to be at least \$84 billion, with a new mobile missile costing at least \$124 billion. Adding in the \$3 billion per year that the RAND study estimates would be the minimum cost of maintaining the new missiles, the total price of developing and deploying a new silo-based missile over the next 40 years would be at least \$204 billion. This sum could be two or three times as much as the estimated \$60-90 billion cost of a life extension program for the Minuteman III over the same time period.<sup>23</sup> Just the research and development stage for a new missile would cost virtually the same amount as keeping the existing arsenal reliable and secure. A newly modernized ICBM would not only provide no conceivable benefit to the U.S. nuclear strategy; it would also be prohibitively expensive.

The most probable explanation for the proposed modernization of the ICBM force is that the Air Force wants to secure continued funding increases for its role in

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<sup>22</sup> Collina, "The Unaffordable Arsenal," 14.

<sup>23</sup> Lauren Caston, et al, "The Future of the U.S. Intercontinental Ballistic Missile Force," *RAND Corporation* (2014): 100-111.

maintaining the nuclear deterrent. The Air Force argues that developing a new ICBM is critical to ensure the survivability of ICBMs, because the new ICBMs will be capable of fitting in reinforced silos that protect them from a potential first strike. However, the 2014 RAND study concluded that current silos provide adequate protection from attacks and are not at risk of being unable to launch their missiles in the event of a first strike.<sup>24</sup> The study concluded that while a completely refurbished missile silo architecture might be desired by the Air Force, it is not a cost-effective or necessary course of action.<sup>25</sup>

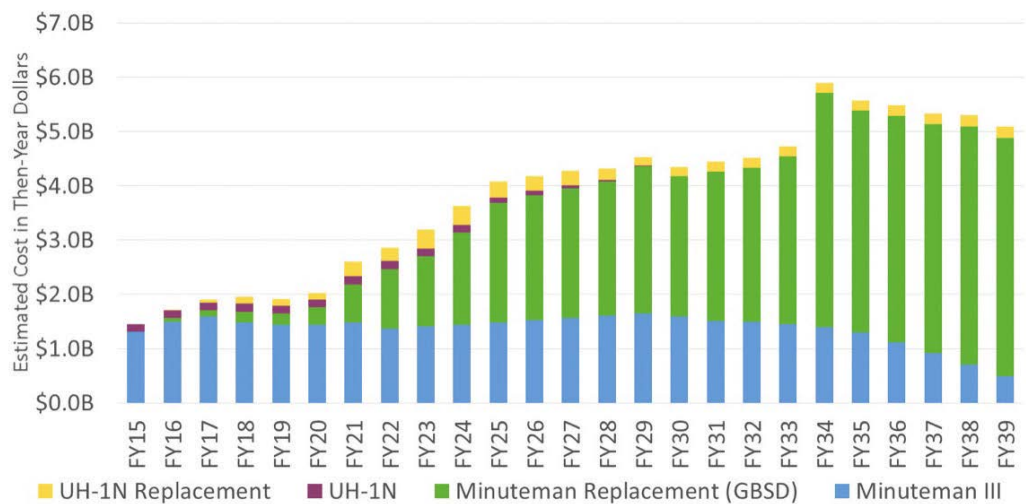


Figure 3: Estimated nuclear-related costs of ICBMs<sup>26</sup>

### Submarines

The Navy’s component of the nuclear triad represents both the most expensive and the most secure part of the United States’ nuclear arsenal. U.S. submarines cannot be tracked by other nations once they are deployed and have the capability to deliver a first or second strike against any nuclear aggressor. The existing naval nuclear fleet

<sup>24</sup> Caston, et al, “Future of the U.S. IBM Force,” 45-47.

<sup>25</sup> Caston, et al, “Future of the U.S. IBM Force,” 47.

<sup>26</sup> Harrison and Montgomery, “The Cost of U.S. Nuclear Forces,” 22.

consists of 14 Ohio-class ballistic missile submarines with a potential capacity of 288 Trident D5 submarine launched ballistic missiles. Each of these missiles has the potential to carry up to eight warheads, making each boat capable of carrying 192 nuclear warheads. The Navy has also proposed building an entirely new class of nuclear submarine, the SSBN(X), while simultaneously retiring existing submarines beginning in 2027. The total cost of developing and building just twelve of the new submarines is projected to be at least \$100 billion, with required refurbishments and upgrades bringing the total cost to \$347 billion over their operational lifetime.<sup>27</sup> The costs of both maintaining the existing submarine fleet for the next fifteen years and developing an entirely new class of ballistic missile submarine are staggering and cannot be contained within current budget constraints. The Navy has already requested additional funds for its submarine program from outside the naval budget by establishing the so-called “Sea-Based Strategic Deterrence Fund”. This fund directly circumvents existing spending limits by externalizing the actual cost of building the new submarines.<sup>28</sup>

This attempted funding reallocation reveals the unsustainable nature of the current nuclear modernization trajectory. The building of twelve new submarines and the progressive phasing out of existing subs is wasteful and entirely unnecessary. Submarine-based nuclear weapons are designed to provide an unassailable and secure second-strike force that can retaliate in the event that other U.S. nuclear forces are destroyed. This does not require submarines to be constantly deployed near potential threats in order to hold them “at-risk”, as current policy dictates.<sup>29</sup> Rather, the Navy

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<sup>27</sup> Collina, “The Unaffordable Arsenal,” 7-8.

<sup>28</sup> Tom Z. Collina and Jacob Marx, “A Better Way to Buy Nuclear Submarines,” *Breaking Defense* (2015).

<sup>29</sup> Collina, “The Unaffordable Arsenal,” 10.

could fulfill its role in the U.S. nuclear deterrent with eight total submarines, and deploy four at any given time.<sup>30</sup> The only reason the Navy argues for twelve submarines is to have multiple submarines directly off the coast of Russia and China ready for a prompt strike.<sup>31</sup> However, deploying submarines this close to the two countries is not necessary, because submarine-launched missiles have the potential to hit targets across the world.

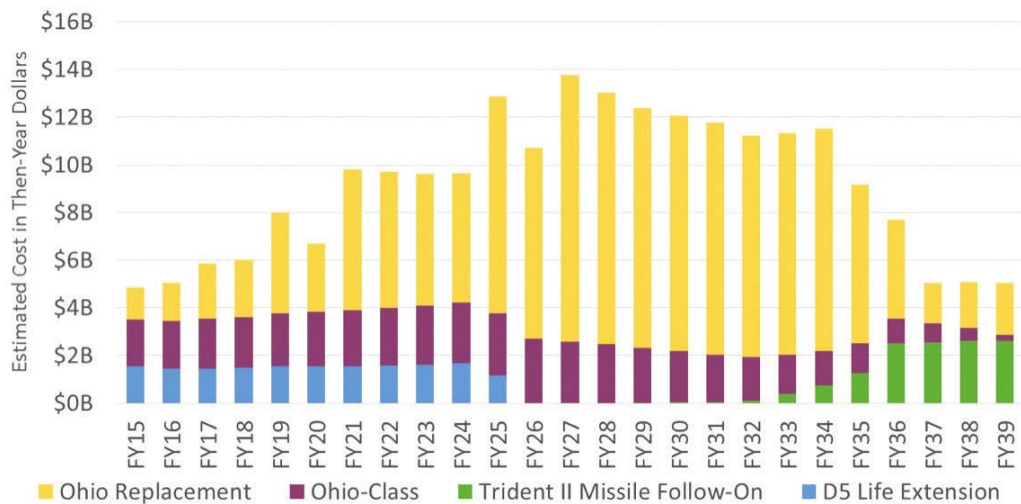


Figure 3: Estimated Nuclear-related costs of Submarine developments<sup>32</sup>

Current modernization plans are overkill for the deterrence requirements of the U.S. nuclear arsenal. No country has the ability to find even a single U.S. nuclear submarine when it is silent and submerged, much less four. While refurbishment and replacement programs could mean that some submarines are docked rather than out at sea, there would still be more than enough nuclear capability in the other parts of the U.S. nuclear arsenal to deter any potential aggressor during refurbishment periods. A smaller submarine fleet would still be able to field the same number of warheads that the current submarine fleet does, but would merely deploy these warheads on fewer

<sup>30</sup> Collina, “The Unaffordable Arsenal,” 10.

<sup>31</sup> Collina, “The Unaffordable Arsenal,” 10.

<sup>32</sup> Harrison and Montgomery, “The Cost of U.S. Nuclear Forces,” 19.

delivery vessels. The strategic value of nuclear submarines is not their ability to rapidly launch nuclear weapons but rather their invulnerability to a potential first strike from another country. Because there is currently no danger to the survivability of the U.S. nuclear submarine force in the foreseeable future a full modernization involving twelve new submarines and warhead upgrades is certainly excessive.<sup>33</sup> In fact, it is widely believed that the twelve submarine modernization plan is largely a jobs program for Connecticut, which stands to benefit greatly from the production of these new submarines.<sup>34</sup>

There are two potential cost-saving options when it comes to the submarine force. The first is to procure eight new Ohio replacements instead of twelve while phasing out the older Ohio class subs. This would save around \$16 billion in procurement costs for the new submarines.<sup>35</sup> A more aggressive plan would reject the new submarine procurement entirely, seeking only to use life extension programs for eight existing submarines for the foreseeable future. This would completely cut the \$347 billion needed to procure and sustain the Ohio replacement over its lifetime. At the very least, the construction of the new submarines could be delayed until the older Ohio-class submarines are at risk of failing. A proposal that fails to construct any new submarines is unlikely to be successful however, as the Navy has already begun to plan for the phasing out of its existing submarines. Constructing only eight instead of twelve is the most realistic option.

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<sup>33</sup> Collina and Marx, “A Better Way to Buy Nuclear Submarines”.

<sup>34</sup> Travis Fain, “Bill: \$46 million to draw 1,000 jobs, new sub program to Newport News,” *Daily Press* (2016).

<sup>35</sup> Collina, “The Unaffordable Arsenal,” 8.

### *Warhead Modernization*

In order to outfit the new modernized nuclear force, the National Nuclear Security Administration (NNSA) has proposed the “3+2” warhead program, which consists of interoperable warheads capable of being deployed on both SLBMs as well as ICBMs. These new interoperable warheads will use parts from multiple different warheads in the current arsenal that have never before been combined, which has prompted substantial concern about the safety of these combinations.<sup>36</sup> Because testing of nuclear weapons is illegal under the Comprehensive Nuclear Test Ban Treaty, critics of the NNSA’s proposal argue that ensuring the safety of the new warheads would require breaching the treaty requirements and prompt other nations to test their own programs. Apart from safety and legal concerns, the development and implementation of an interoperable warhead program would cost substantially more than existing warhead life extension programs. The IW-1, the first of three proposed interoperable warheads, has a projected development cost of \$11 billion while a life extension program for a single warhead in the Navy’s arsenal, the W76, costs only \$5 billion. Development costs do not even take into account the production and outfitting of the existing arsenal, which means that the final cost of the IW-1 could be at least four times as much as pursuing a life extension program. Because of the high costs of developing even a single new series of interoperable warheads, Congress has already delayed the program by pushing the development of the IW-1 from 2025 to 2030.

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<sup>36</sup> Tom Z. Collina, “Future of ‘3+2’ Warhead Plan in Doubt,” *Arms Control Today* 44 (2014): 1.

### The '3+2' Plan vs. Traditional Life-Extensions

Delivery Systems	Warheads/ Bombs	NNSA 3+2 Plan	Production Start Date	Est. Cost 2014-2039	Regular LEPs	Estimated Cost
ICBMs	W87	Replace with IW-2	2034	\$15 billion	W87 LEP	\$5 billion
	W78	Replace with IW-1	Delayed from 2025 to 2030	\$11 billion	Retire W78	--
SLBMs	W88				W88 LEP	\$5 billion
	W76	Replace with IW-3	2041	\$20 billion	W76 LEP	\$5 billion
Bombers	B61-3/4/7/10 Bomb	Replace with B61-12	2020	\$8-10 billion	Scaled-back B61 LEP	\$5 billion
	W80-1 ALCM	Replace with W84 or W80-1	Delayed from 2024 to 2027	\$7 billion	Retire W80-1	--
	B83 Bomb	Retire once B61-12 is produced		--	Retire B83	--
<b>Total Cost</b>				<b>\$61 billion</b>		<b>\$20 billion</b>

Sources: National Nuclear Security Administration, ACA

Figure 4: Comparison of interoperable warhead and LEP costs<sup>37</sup>

The former director of the Lawrence Livermore National Laboratory, Penrose Albright, has stated that the Navy would prefer to refurbish its W88 warhead in the same manner that it refurbished the W76 instead of adopting the IW-1. Albright also noted that consistent refurbishment programs by the Air Force and Navy serve to simplify the nuclear arsenal while constant reforms simply complicate nuclear strategy.<sup>38</sup> Not only are the LEPs for existing warheads much easier to manage, but they are also far less expensive. If just the interoperable warhead program was cancelled in favor of continuing LEPs, the U.S. would stand to save \$31 billion between 2014 and 2039. LEPs would also remove any potential additional cost associated with retrofitting existing missiles with new interoperable warheads. This interoperable warhead program

<sup>37</sup> Retrieved from Arms Control Association “NNSA’s ‘3+2’ Nuclear Warhead Plan Does Not Add Up”.

<sup>38</sup> Collina, “Future of 3+2 Warhead Plan in Doubt,” 2.



represents an unnecessary expenditure that complicates the nuclear arsenal for no reason.

The NNSA has also proposed a modernization program for the gravity bombs deployed by the Air Force, with its new B61-12 warhead designed to replace all of the existing B61 versions currently present in the U.S. nuclear arsenal. The B61-12 is argued by the NNSA to represent a cost-effective consolidation of existing versions of the B61 into a single weapon that can accomplish all of the military objectives that the other versions of the B61 are currently used for.<sup>39</sup> If this consolidation actually represented savings for the nuclear arsenal, it would be a reasonable proposal. However, the actual costs of the B61-12 are drastically different from the NNSA's projections. Each B61-12 costs \$28.9 million, more than twice its weight in gold. The estimated cost of the entire B61-12 program is \$11.6 billion dollars, more than the total defense spending of countries like Spain, the Netherlands, and Poland.<sup>40</sup> In comparison, an LEP for existing versions of the B61 would cost only \$5 billion, representing a savings of over \$6 billion. There is no indication that the refurbished B61-12 would serve any purpose other than to waste money on an essentially cosmetic upgrade to existing B61s. This program should be cut in favor of LEPs for existing B61s.

If the maximum proposed cuts are made to each modernization proposal, total savings could be at least \$271 billion dollars. This number assumes that the only modernization that is pursued is the construction of eight new Ohio class submarines, with all other programs being either cut or replaced by LEPs.

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<sup>39</sup> Hans M. Kristensen, "Capabilities of B61-12 Nuclear Bomb Increase Further," *Strategic Security Blog* (2013).

<sup>40</sup> Ben Loehrke, "Meet the Budget Busting B61 Nuclear Bomb," *Ploughshares.org* (2013).

## **Nuclear Modernization Threatens the Underpinnings of the NPT**

The Nuclear Non-Proliferation Treaty (NPT) entered into force in 1970 with the purpose of regulating nuclear arsenals. This treaty prohibits all nations except those with existing nuclear weapons from developing a nuclear arsenal and calls on existing nuclear states to reduce their nuclear arsenals with the ultimate goal of complete disarmament.<sup>41</sup> The recent conclusion of the Nuclear Non-Proliferation Treaty Review Conference in May 2015 brought with it a reaffirmation of the international consensus that nuclear weapons should be reduced and ultimately phased out of existence.<sup>42</sup> However, the existing trajectory of modernization across the world indicates that this consensus has not led to actual implementation; every nuclear weapon state is beginning to escalate modernization efforts and there is no sign of the disarmament that the NPT calls for.<sup>43</sup> Additionally, other non-nuclear countries have been drawn into this process of modernization. The U.S. has involved non-nuclear nations in its nuclear defense program by stationing nuclear weapons in multiple NATO member states that do not have nuclear arsenals of their own. This directly violates the NPT Treaty which states that non-nuclear NPT signatories are obligated “not to receive the transfer from any transferor whatsoever of nuclear weapons or other nuclear explosive devices or of control over such weapons or explosive devices directly, or indirectly”.<sup>44</sup> A 2015 report by the Reaching Critical Will project illustrates that every nuclear power is pursuing

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<sup>41</sup> Arms Control Association, “The Nuclear Nonproliferation (NPT) Treaty at a Glance,” (2012).

<sup>42</sup> United Nations, “2015 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons”.

<sup>43</sup> Hans M. Kristensen, “Nuclear Weapons Modernization: A Threat to the NPT?,” *Arms Control Today* 44 (2014): 1.

<sup>44</sup> Kristensen, “Nuclear Weapons Modernization: A Threat to the NPT?,” 3.

modernization programs, largely due to the continued refusal of the U.S. and Russia to commit to an international regime culminating in the elimination of nuclear weapons.<sup>45</sup>

In the following sections, I will examine the modernization programs being pursued by major nuclear powers around the world. In each instance, I will argue that the modernization efforts of the United States discussed earlier are directly responsible for the modernization of other arsenals. After illustrating the relationship between U.S. modernization and other modernization efforts, I argue that the U.S. has the potential to reverse this trend by changing its own posture on modernization and setting an example for the rest of the world.

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<sup>45</sup> Ray Atcheson, et al, "Assuring Destruction Forever: 2015 Edition," (2015).

	Weapon Category	New or Modernized Weapon <sup>1</sup>
<b>RUSSIA</b>		
	<i>Strategic Land</i>	Sarmat ICBM (silo) SS-27 Mod 2 (RS-24) ICBM (silo) SS-27 Mod 2 (RS-24) ICBM (mobile) New ICBM (RS-26) (mobile) Probably new (including maneuverable) warhead
	<i>Strategic Sea</i>	Borei SSBN SS-N-32 (Bulava) SLBM Probably new warhead
	<i>Strategic Air</i>	PAK-DA bomber Kh-102 ALCM
	<i>Tactical</i>	Su-34 fighter-bomber Severodvinsk (Yasen) SSN SS-N-30 (Kalibr) SLCM SS-26 Iskander-M SRBM S-400/SA-21 SAM (?) Interceptor for A-135 ABM system
<b>UNITED STATES</b>		
	<i>Strategic Land</i>	ICBM IW-1 interoperable warhead
	<i>Strategic Sea</i>	SSBNX Trident IID5LE SLBM W76-1/Mk4A warhead W88-1/Mk5A warhead
	<i>Strategic Air</i>	Long-range strike bomber Long-range standoff ALCM B61-12 bomb
	<i>Tactical</i>	F-35A fighter-bomber B61-12 bomb
<b>NATO</b>		
<b>Belgium</b>	<i>Tactical</i>	(F-35A fighter-bomber) <sup>2</sup>
<b>Germany</b>	<i>Tactical</i>	
<b>Italy</b>	<i>Tactical</i>	F-35A fighter-bomber
<b>Netherlands</b>	<i>Tactical</i>	F-35A fighter-bomber
<b>Turkey</b>	<i>Tactical</i>	F-35A fighter-bomber
<b>FRANCE</b>		
	<i>Strategic Sea</i>	M51.2 SLBM M51.3 SLBM TNO warhead
	<i>Tactical<sup>3</sup></i>	Rafale-3 fighter-bomber
<b>CHINA</b>		
	<i>Strategic Land</i>	DF-31 ICBM DF-31A ICBM (DF-41 ICBM) <sup>4</sup> Potentially MIRVed warhead
	<i>Strategic Sea</i>	Jin SSBN JL-2 SLBM New warhead
	<i>Strategic Air</i>	H-6K bomber CJ-20 ALCM <sup>5</sup>
	<i>Tactical</i>	DH-10 GLCM <sup>6</sup>
<b>UNITED KINGDOM</b>		
	<i>Strategic Sea</i>	New SSBN Trident II D-5LE SLBM Modified W76-1/Mk4A warhead
<b>PAKISTAN</b>		
	<i>Strategic Land<sup>7</sup></i>	Hatf-2 Abdali SRBM Hatf-4 Shaheen IA MRBM Hatf-6 Shaheen II MRBM Hatf-7 Babur GLCM Smaller plutonium warheads
	<i>Strategic Air</i>	Ra'ad ALCM
	<i>Tactical</i>	Hatf-9 NASR SRBM Smaller warhead
<b>INDIA</b>		
	<i>Strategic Land</i>	Agni III IRBM Agni IV IRBM Agni V IRBM (Agni VI ICBM) Potentially MIRVed warhead
	<i>Strategic Sea</i>	Arihant SSBN K-15 Sagarika SLBM K-4 SLBM Existing or modified warhead
	<i>Strategic Air</i>	(Rafale fighter bomber)
<b>ISRAEL</b>		
	<i>Strategic Land</i>	Jericho III MRBM
	<i>Strategic Air</i>	(F-35A fighter-bomber)
<b>NORTH KOREA</b>		
	<i>Strategic Land</i>	Musudan IRBM Hwasong-13 (KN-08) ICBM Taepo Dong ICBM (One or more warheads) <sup>8</sup>

Figure 5: Table of nuclear modernization programs<sup>46</sup>

## Russia

In 2013, Russian President Vladimir Putin announced that Russia would pursue a series of nuclear modernizations in order to counter emerging global threats; a thinly veiled reference to current U.S. modernization programs. Russia's current modernization plan includes 400 new ICBMs, a fleet of eight new strategic nuclear

<sup>46</sup> Kristensen, "Nuclear Weapons Modernization: A Threat to the NPT?".

submarines, and preliminary development of a modernized long-range nuclear bomber. It is no coincidence that these modernizations mirror those proposed by the United States. Russian modernizations represent an attempt to possess the same technology and number of warheads as the United States.<sup>47</sup> Russian statements on nuclear arms reductions consistently emphasize that Russia will follow the U.S. on arms control measures, but will not reduce its number of warheads or delivery systems without a corresponding U.S. reduction.<sup>48</sup> Additionally, the Russian government presents its current modernization programs to the public as an essential component of maintaining Russia's strength given U.S. modernization.<sup>49</sup>

The similarity of Russian modernization programs to their U.S. counterparts as well as the justifications presented by the Russian government for pursuing modernization seem to indicate that the primary driver of Russian nuclear modernization is the United States' own modernization program. Total Russian military modernization plans are projected to cost over \$700 billion starting in 2018, with a minimum of \$70 billion likely allocated for nuclear modernization programs.<sup>50</sup> Despite the exorbitant price tag that this modernization will have, the Russian government continues to pursue a modernized arsenal to counter the U.S. buildup. Given recent international tensions over Crimea, a unilateral halt to modernization in Russia seems out of the question as long as U.S. modernization continues.

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<sup>47</sup> Atcheson, et al, "Assuring destruction forever," 14.

<sup>48</sup> Atcheson, et al, "Assuring destruction forever," 69.

<sup>49</sup> Atcheson, et al, "Assuring destruction forever," 70.

<sup>50</sup> Atcheson, et al, "Assuring destruction forever," 14.

## *China*

Since its inception as a nuclear power in 1964, China has pursued a minimal nuclear deterrent strategy and has consistently been very transparent about the intent behind its nuclear arsenal. China is the only nuclear weapon state under the terms of the Nuclear Non-Proliferation Treaty that has pledged to never be the first to utilize nuclear weapons, and it has reaffirmed this commitment in 2005, 2006, 2008, 2009, and again in 2011.<sup>51</sup> Chinese leaders have also continuously emphasized China's policy of minimum deterrence, which is designed to absorb a first strike and still have sufficient retaliatory potential to inflict damage on enemy cities. The 2010 Chinese Defense White Paper states that China will never enter into a nuclear arms race with another nation since such an arms race would not be conducive to China's nuclear policy.<sup>52</sup> Chinese actions on the international stage regarding arms reduction talks have been very much in line with the PRC's nuclear policy, with Chinese officials seeking deep global reductions in arms

China has historically maintained a very small arsenal designed for "minimum deterrence". According to Chinese officials, only ten warheads need to be capable of hitting targets in another country in order to deter that country from launching a first strike against China.<sup>53</sup> This posture has led China to maintain one of the smallest arsenals in the world, with estimates putting China's total nuclear missile stockpile at around 200.<sup>54</sup>

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<sup>51</sup> Andrew Erickson et al, "China's Future Nuclear Submarine Force," *Naval Institute Press* (2012): 338.

<sup>52</sup> Lt. Col. David D. Kelley, "Confronting the Reality of a Rising Nuclear-armed China," (2013): 28.

<sup>53</sup> Atcheson, et al, "Assuring destruction forever," 22.

<sup>54</sup> Atcheson, et al, "Assuring destruction forever," 23.

China has increased its total warhead count over the last fifteen years, and has recently begun modernizing its delivery systems and weapons. With the nuclear material that it possesses, China has the potential to field close to seven hundred nuclear warheads.<sup>55</sup> The current estimate of new production puts the number of new warheads produced by China each year at between ten and twenty. To ensure the survivability of its nuclear force, China has also invested in mobile missile technology and reinforced launching sites.<sup>56</sup> Recent upgrades to Chinese missiles have focused on improving launch times by replacing liquid fuels in the missiles with solid fuel. The Chinese land-based nuclear arsenal is being modernized with an increased focus on multiple independently targeted re-entry vehicles (MIRVs) as well as maneuverable re-entry vehicles.<sup>57</sup> MIRV technology would ensure that the survival of even a very small part of the Chinese land based arsenal would be sufficient to cause unacceptable damage to an aggressor and make it more difficult to conduct a first strike that eliminates most of China's nuclear capabilities. The most significant change in the Chinese arsenal has been the recent deployment of multiple nuclear-armed submarines. China previously only operated a single Xia-class submarine until it completed the construction of three Jin-class submarines in 2014.<sup>58</sup> The deployment of more submarines seems to indicate that China is highly concerned about the survivability of its arsenal and believes that more delivery platforms are necessary to ensure its minimum deterrence posture.

Chinese modernization is very much a response to the modernization efforts of the United States. Many Chinese officials perceive the new weapons that the U.S. is

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<sup>55</sup> Erickson, et al, "China's Future Nuclear Submarine Force," 333.

<sup>56</sup> Atcheson, et al, "Assuring destruction forever," 22.

<sup>57</sup> Atcheson, et al, "Assuring destruction forever," 23-24.

<sup>58</sup> Atcheson, et al, "Assuring destruction forever," 24.

building as an attempt to develop a usable first-strike force that could destroy China's capability to retaliate.<sup>59</sup> Given this perception, it makes sense that China would pursue modernization efforts designed to increase the size of its arsenal as well as ensure that some of its nuclear forces would be able to survive a potential first strike. Even though U.S. modernizations would not actually increase the viability of a first strike on China, it appears to the Chinese government that gearing up for a first strike is the justification behind proposed modernizations. China's official stance on disarmament also indicates that it sees the United States' modernization programs as necessitating Chinese modernizations. China has stated that it would follow the U.S. and Russia on disarmament policies, but refuses to do so while the U.S. and Russia pursue modernization.<sup>60</sup> This demonstrates that U.S. modernization is at the heart of the upgrades being made to the Chinese arsenal.

### *India and Pakistan*

The tensions between China and the U.S. over nuclear forces have prompted increased modernization efforts in both India and Pakistan. India is pursuing a nuclear triad much like the U.S., with the development of the new Agni-V missile and the expansion of the Indian nuclear reactor complex indicating a drive for a modernized nuclear arsenal.<sup>61</sup> India's nuclear program has been developing more advanced weaponry that can target population centers in China, indicating that India sees China's

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<sup>59</sup> Atcheson, et al, "Assuring destruction forever," 27.

<sup>60</sup> Atcheson, et al, "Assuring destruction forever," 8.

<sup>61</sup> Atcheson, et al, "Assuring destruction forever," 11.



nuclear program as a growing threat.<sup>62</sup> The development of new submarines illustrate India's concerns about the survivability of its arsenal and also likely represent an attempt to maintain parity with China's submarine force.<sup>63</sup>

In response to the modernization efforts of India, Pakistan is developing nuclear cruise missile technology and more accurate medium-range solid-fueled missiles, which would dramatically reduce the time necessary to launch a nuclear strike.<sup>64</sup> Pakistan's arsenal has also seen a numerical increase from around 100 nuclear weapons in 2011 to over 130 by the end of 2014.<sup>65</sup> This increase is believed by many experts to represent a continued effort to achieve parity with India's nuclear forces.<sup>66</sup> Pakistan's government uses this logic to justify spending on modernization to its people, who have long seen Pakistan's nuclear program as a symbol of pride as well as a critical defense against potential aggression by India.<sup>67</sup> However, its extreme spending on modernization has made Pakistan greatly dependent on international humanitarian aid in order to alleviate economic hardship.<sup>68</sup>

Modernization in India and Pakistan is directly linked to modernization in the U.S. and China. As China has been forced to modernize its arsenal in response to U.S. efforts, India has felt the need to develop its arsenal to remain on par with China. India's modernization has then prompted Pakistan to modernize its own arsenal to match India's arsenal. This cascading effect begins with the United States, and illustrates the ripple effects that modernization has on security relationships between

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<sup>62</sup> Atcheson, et al, "Assuring destruction forever," 43.

<sup>63</sup> Atcheson, et al, "Assuring destruction forever," 39.

<sup>64</sup> Atcheson, et al, "Assuring destruction forever," 13.

<sup>65</sup> Atcheson, et al, "Assuring destruction forever," 54.

<sup>66</sup> Atcheson, et al, "Assuring destruction forever," 60.

<sup>67</sup> Atcheson, et al, "Assuring destruction forever," 61.

<sup>68</sup> Atcheson, et al, "Assuring destruction forever," 13.

multiple countries. Neither Pakistan nor India would have a reason to modernize their arsenals if it were not for Chinese modernization, which results from the United States' expansion of its own modernization programs.

### *France and the United Kingdom*

Despite being allied with the United States and having security agreements regarding nuclear attacks, France, the United Kingdom, and Israel are also marching down the costly path to a modernized nuclear arsenal. France is pursuing a new nuclear submarine and is continuing to develop its force of air launched cruise missiles, with a modernized bomber (the Rafale) already beginning to replace the existing bomber force.<sup>69</sup> France's 2015 budget included \$3.4 billion for nuclear weapons activities, around one-third of its total defense budget.<sup>70</sup> Even though this sum pales in comparison to U.S. efforts in terms of total cost, the U.S. spends nowhere near one-third of its total defense budget on nuclear weapons. France's allocation of its defense budget demonstrates that it views nuclear weapons as a critical component of its national security. President Hollande's 2015 statement on the nuclear arsenal reaffirmed the importance of nuclear weapons, and indicated that France has no intention of reducing its 300 warhead arsenal as long as the U.S. and Russia remain on their current trajectory of modernization.<sup>71</sup>

The United Kingdom also has no intention of drastically reducing its nuclear arsenal. One senior Conservative Member of Parliament argued that Britain should

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<sup>69</sup> Atcheson, et al, "Assuring destruction forever," 9.

<sup>70</sup> Atcheson, et al, "Assuring destruction forever," 35.

<sup>71</sup> Atcheson, et al, "Assuring destruction forever," 36.

retain its nuclear arsenal because leaving “France as the only nuclear power in Europe would be a reckless piece of irresponsibility”.<sup>72</sup> Not only is the U.K. maintaining its current nuclear arsenal, it is also proposing new modernizations to both warheads and its submarine forces. The new Mk4A warhead is designed to replace existing warheads in the U.K.’s arsenal as well as be deployed on its new submarines. These new submarines are designed as a replacement for the existing Trident submarines used by the U.K.<sup>73</sup> The cost of three to four new ballistic missile submarines is estimated to be \$100 billion over their operational lifetime.<sup>74</sup> This investment indicates that the U.K. is continuing to emphasize its nuclear force as a central component of its national security, and is unlikely to reduce its forces in the near future.

Both France and the U.K. see other modernization programs as justifications for continuing to improve their own arsenals. The comments of officials in both countries indicate that any potential reductions to nuclear arsenals would necessitate a corresponding reduction by the U.S. and Russia. Furthermore, modernizations to submarines in the U.K. and to bombers in France are very similar to the modernizations made by the United States. These similarities likely indicate a desire for technological parity with the U.S. as well as an increased focus on secure deterrent forces. As long as the United States continues its focus on modernization and spurs Russia to modernize its arsenal, France and Britain will continue to upgrade their arsenals in similar ways.

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<sup>72</sup> Atcheson, et al, “Assuring destruction forever,” 79.

<sup>73</sup> Atcheson, et al, “Assuring destruction forever,” 79.

<sup>74</sup> Atcheson, et al, “Assuring destruction forever,” 15.

### *The U.S. Could Reverse Global Modernization Trends*

The fact that every nuclear-armed nation is currently in the process of modernizing their nuclear arsenals indicates that the commitment to continual arms reductions and eventual disarmament made by nuclear powers in the NPT are not leading to the global nuclear reductions that the treaty envisioned. Rather, nuclear-armed states are now going in the wrong direction, spending billions on modernization programs and increases in nuclear stockpiles that run counter to the NPT.

As illustrated above, the U.S. modernization programs are the primary driver of global nuclear modernization efforts. Because of its role in prompting modernization, the U.S. needs to be the country that takes the lead on reversing the current trajectory of modernization. If U.S. modernization were to cease, Russia and China would no longer be motivated to modernize their own arsenals. This in turn would likely halt modernization in India, Pakistan, France, and Britain, as each of these countries justifies its modernization programs through the existence of other such programs. Every modernization effort can be traced back to the United States' modernization, which makes halting the U.S. modernization effort a pre-requisite to stopping modernization in every other country.

Nuclear modernization in the United States prompts global arms races and irresponsible expenditures that detract from the welfare of citizens in every nation. In order to address U.S. nuclear modernization, it is necessary to examine the organizational impetus behind modernization efforts. The primary organization responsible for the U.S. trajectory of modernization is the National Nuclear Security Administration and its eight laboratories, which create the warheads for every nuclear

weapon in the U.S. arsenal. This means that the NNSA and its laboratories have a stake in every modernization program. Addressing the national security laboratories thus becomes critical to resolve modernization.

## **Key Conversion: The National Security Laboratories**

The NNSA maintains eight national security laboratories in order to manage the United States' nuclear stockpile and sustain current modernization efforts. These labs are split into three distinct categories by the NNSA: national nuclear weapons design laboratories—the Los Alamos, Sandia, and Lawrence Livermore National Laboratories, one testing site—the Nevada National Security Site, and production plants—the Pantex Plant, Kansas City Plant (now better known as the National Security Campus), the Savannah River Site, and Y-12 National Security Complex. The current funding proposal for 2016 allocates \$12.6 billion to the entire national security laboratory complex and represents an increase of 10.2% over the 2015 funding levels.<sup>75</sup> This proposal represents the highest level ever of U.S. spending on nuclear weapons activities in absolute dollars (\$8.84 billion). Current NNSA plans call for maintaining all eight national laboratories and having each lab continue to focus on nuclear weapons activities. Unless these plans are changed they will necessitate budget increases for the NNSA until at least 2040 given the current trajectory of modernization.<sup>76</sup> If the existing modernization proposals are implemented, NNSA funds will continue to be used at the laboratories to develop new weaponry for the nuclear arsenal and upgrade existing components.

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<sup>75</sup> From the NNSA Budget Website: <http://nnsa.energy.gov/aboutus/budget>.

<sup>76</sup> Atcheson, et al, "Assuring destruction forever," 16.

<b>Lab Name</b>	<b>Employees</b>	<b>Budget (in billions)</b>	<b>Approximate Weapons Activities Budget (in billions)</b>	<b>Contractor</b>
Los Alamos National Laboratory	7,430	\$2.1	\$1.3	Los Alamos National Security, LLC
Lawrence Livermore National Laboratory	6,800	\$1.2	\$.981	Lawrence Livermore National Security, LLC
Sandia National Laboratory	10,700	\$1.8	\$1.5	Sandia Corporation
Nevada National Security Site	1,900	\$0.396	\$0.244	National Security Technologies, LLC
Pantex Plant	3,600	\$0.604	\$0.602	Consolidated Nuclear Security, LLC
Kansas City Plant	2,500	\$0.579	\$0.562	Honeywell Federal Manufacturing and Technologies
Savannah River Site	12,000	\$1.4	Minimal	Savannah River Nuclear Solutions, LLC
Y-12 National Security Complex	4,600	\$1.2	\$1.15	Consolidated Nuclear Security, LLC

The NNSA argues that each laboratory fulfills a specific part of the nuclear weapons maintenance program that cannot be successfully performed at any other site and that a consolidation of the sites would represent a threat to the proper functioning of the nuclear arsenal. In order to determine the necessity of each site's role in the maintenance of the nuclear stockpile each site will be examined individually. It is important to note that effective maintenance of the stockpile and modernization are two distinct goals. A consolidation plan that manages to keep the United States' deterrent secure but does not allow for modernization would be a viable option given the danger that a modernized arsenal presents to the international community.

## **A New Manhattan Project**

The national laboratories were originally created to fulfill the goal of the Manhattan Project; namely to create a weapon that would be capable of winning World War II for the United States. This project involved many of the best scientists and engineers in the U.S. all working together towards a common goal that was essential during the war. Because the labs all had this shared goal that unified and motivated them, they were incredibly effective at fulfilling the objective of the Manhattan Project. Today, there is no longer the same project driving the labs. Each lab currently attempts to maintain itself as an organization and secures funding by justifying spending on new nuclear weapons that do nothing to actually contribute to U.S. national security. Instead, these new projects waste resources and provoke other states to build new nuclear weapons capabilities. Rather than be used to continue this outdated Cold War mission, these national security labs need to be repurposed for a new Manhattan Project.

The stagnant and outdated mission that the labs are currently pursuing must be changed in order to recapture the same productive power that the labs harnessed during the Manhattan Project. In order to be positive agents in U.S. policy, the labs need a new Manhattan Project that is directed at one of the major challenges facing the U.S. today. As the following descriptions of the labs will demonstrate, the labs are already well-suited to pursue the problem of climate change. All that is required is a shift in the overall mission of the labs in order to orient them in this manner. While the labs currently depend on nuclear modernizations in order to keep their resources, a new Manhattan Project would enable the labs to abandon these projects without losing any of their funding.



## Lab Descriptions

### *Los Alamos National Laboratory*

Los Alamos was one of the first labs founded in order to conduct research for the Manhattan Project during World War II. Because of the difficulty of coordinating a secret project across many different universities and locations across the country the leaders of the Manhattan Project decided to establish a centralized location for the development and testing of nuclear weapons.<sup>77</sup> With the end of World War II and after the use of nuclear weapons against Hiroshima and Nagasaki, Los Alamos shifted to the development of thermonuclear weapons and rapidly expanded the U.S. nuclear arsenal. While the University of California was responsible for managing Los Alamos until 2003, the Department of Energy then opened the management contract to other bidders, including private firms. In 2006, the lab's management was taken over by Los Alamos National Security, LLC, a for-profit corporation including the University of California as well as the Bechtel Corporation, Washington Group International, and the Babcock and Wilcox Technical Services Group.<sup>78</sup> Since 2006 other bidders have not had an opportunity to attempt to take over, entrenching Los Alamos National Security, LLC as the management of Los Alamos for the foreseeable future. Los Alamos employs 7,430 workers and has a total yearly budget of \$2.1 billion, two-thirds of which is dedicated to nuclear weapons activities.<sup>79</sup>

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<sup>77</sup> Robert Civiak, et al, "Transforming the U.S. Strategic Posture and Weapons Complex for Transition to a Nuclear Weapons-Free World," *National Resources Defense Council* (2009): 52.

<sup>78</sup> Union of Concerned Scientists, "The U.S. Nuclear Weapons Complex: Major Facilities," *Nuclear Weapons Policy* (2013). All other footnotes from the UCS are the lab sub-sections under this report on the national security laboratories.

<sup>79</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 52.

Ever since its inception Los Alamos has been a unique site for nuclear weapons research and production. It possesses the only fully functioning plutonium pit manufacturing facility in the nuclear weapons complex, the Plutonium Facility-4. Plutonium pits are the core of any nuclear weapon, and serve to initiate the thermonuclear reaction that gives these weapons their destructive potential. Despite the commitment by the United States to reduce and retire its nuclear arsenal, the future role for Los Alamos envisioned by the NNSA emphasizes pit production capabilities and weapons testing while phasing out current environmental impact studies and waste disposal efforts at the site designed to minimize the environmental impact of that expansion.<sup>80</sup> The most expensive construction proposal at Los Alamos is the Chemistry and Metallurgy Research Replacement Facility, which would enable the production of more plutonium pits for the nuclear arsenal. Because of the excessive costs and unclear benefit of such a facility, the Obama administration has already delayed construction for a minimum of five years. The fact that the CMRR Facility would enable more plutonium pits to be produced indicates that it would likely be used to expand the nuclear arsenal rather than to continue decreasing its total size.<sup>81</sup> An emphasis on pit production facilities demonstrates that the NNSA intends to continue constructing additional nuclear weapons instead of relying on existing ones, as new plutonium pits have no function other than to be deployed in new nuclear warheads.

Los Alamos is also the lab most interested in refurbishing and modernizing the B61 bomb as it was responsible for the initial development of fifteen different versions of the B61 that were then adopted by the military. Los Alamos became responsible for

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<sup>80</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 53-54.

<sup>81</sup> Peter Stockton, "U.S. Nuclear Weapons Complex: Energy Department Plans to Waste Billions of Dollars on Unneeded Los Alamos Lab Facility," *Project on Government Oversight* (2012).

the development of the weapon shortly after the Cuban missile crisis, and over the course of the next 50 years it continued to propose additional modifications and extra versions of the B61. Los Alamos argued that each new upgrade was necessary for the fulfillment of a specific nuclear mission and had a critical role to play in the U.S. nuclear deterrent.<sup>82</sup> This close connection to the B61 makes it highly plausible that Los Alamos has a vested interest in pursuing the B61-12 modernization program, as this would provide continued funding and a justification for the development of new nuclear weapons under the current U.S. nuclear trajectory.

#### *Lawrence Livermore National Laboratory*

The Lawrence Livermore National Laboratory was the second lab created to oversee the design of nuclear weapons. Its primary mission was to serve as a competitor for weapons designers at Los Alamos in order to maximize the push for innovation at both laboratories. Livermore developed the initial version of a submarine-launched ballistic missile and spearheaded the creation of the first warheads for MIRVed missiles. The current mission of the lab is to maintain and test its developed warheads (the W62 and W87 ICBM warheads as well as the W84 ground-launched cruise missile) and to spearhead the life extension program for the W78 warhead that was originally designed at Los Alamos.<sup>83</sup> Livermore was managed by the University of California but in 2007 was subject to a shift in management to Lawrence Livermore National Security, LLC (consisting of the Bechtel Corporation, Babcock and Wilcox, Washington Division

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<sup>82</sup> Hans M. Kristensen and Robert Norris, "The B61 family of nuclear bombs," *Bulletin of the Atomic Scientists* (2014).

<sup>83</sup> Union of Concerned Scientists, "Lawrence Livermore National Laboratories," 1.

of URS Corporation, and Battelle Memorial Institute).<sup>84</sup> The budget for Lawrence Livermore in 2013 was \$1.19 billion, 82% (\$981 million) of which was earmarked for weapons activities. Livermore currently has 6,800 employees.<sup>85</sup>

Lawrence Livermore houses the so-called “Superblock” site, which in addition to Los Alamos is one of the only two sites that store plutonium and weapons-grade uranium. While the NNSA proposed transferring all plutonium to Los Alamos in order to consolidate nuclear materials, the delays in constructing the replacement facilities at Los Alamos have hampered this process. This delay raises substantial security concerns as Livermore failed a security test in 2008, in which mock attackers were able to successfully infiltrate the compound and acquire enough plutonium to construct a dirty bomb.<sup>86</sup> The proximity of Livermore’s location to highly populated areas in San Francisco makes the potential theft of nuclear materials at the site especially problematic, as 7 million people live within 50 miles of the facility. Even disregarding the possibility of theft, Livermore already has negative effects on the environment with the EPA placing all of Livermore’s sites on the Superfund list of contaminated sites requiring immediate cleanup.<sup>87</sup> The first priority at Livermore should be ensuring that the existing facilities do not cause continued environmental damage, not modernizing weapons while allowing this environmental damage to be exacerbated.

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<sup>84</sup> Civiak, et al, “Transforming the U.S. Strategic Posture,” 55.

<sup>85</sup> Union of Concerned Scientists, “Lawrence Livermore National Laboratories,” 2.

<sup>86</sup> Union of Concerned Scientists, “Lawrence Livermore National Laboratories,” 3.

<sup>87</sup> Civiak, et al, “Transforming the U.S. Strategic Posture,” 57.

## *Sandia National Laboratory*

The Sandia National Laboratory was created to manage production requirements for the nuclear weapons designed by Los Alamos and Lawrence Livermore. For this reason, it has two locations, one near Los Alamos and one in Livermore, California.<sup>88</sup> After the moratorium on new nuclear testing in 1992 Sandia became responsible for maintaining the reliability of the U.S. nuclear stockpile through non-explosive experiments. While Los Alamos and Lawrence Livermore handle the nuclear warheads Sandia is responsible for the non-nuclear components of warheads and pairing warheads with their nuclear delivery systems.<sup>89</sup> With its 10,700 employees, Sandia deals with miniature electronics and precise systems for nuclear weapons while simultaneously conducting research and development into new forms of high explosives. Sandia's budget in 2014 was \$1.8 billion, with approximately \$1.5 billion being allocated for the production and maintenance of weapons systems. Sandia is managed by the Sandia Corporation, a subsidiary of Lockheed Martin.<sup>90</sup>

Sandia is fundamentally connected to the life extension programs for existing warheads, as it produces non-nuclear components for all warhead classes. Successful life extension programs conducted by Sandia include the development of a refurbished W76 submarine-launched ballistic missile which involved modifying key components of the warhead to ensure reliability and durability in a number of firing conditions. Most of the recent LEP funding to Sandia has now been re-allocated for the development of the B61-12 which has led to delays in the refurbishment of other weapons in the nuclear

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<sup>88</sup> Union of Concerned Scientists, "Sandia National Laboratories," 1.

<sup>89</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 58.

<sup>90</sup> Union of Concerned Scientists, "Sandia National Laboratories," 3.

arsenal.<sup>91</sup> In addition to developing new bomb systems Sandia is also pursuing life extension programs for the W78 ICBM and W88 SLBM, with many of the components developed for each of the warheads having the potential of being used in an interoperable warhead on both ICBMs and SLBMs. While Sandia has consistently ensured the reliability of existing warheads it is important to ensure that the mission of refurbishment does not overlap with the development of modernized delivery vehicles or increased usability of the nuclear arsenal. As the B61-12 illustrates, new modernization programs require a shift away from LEPs and thus threaten the reliability of the current nuclear arsenal.

#### *Nevada National Security Site*

The Nevada National Security Site (NNSS) had always been a primary large-scale nuclear testing ground for the United States until the signing of the Limited Test Ban Treaty made the NNSS the only permitted site for U.S. nuclear testing. Despite the absence of large nuclear tests the isolated location of the NNSS makes it a perfect testing ground for components of the U.S. nuclear arsenal. The NNSS has been used primarily to conduct subcritical tests for existing parts of the nuclear arsenal in recent years, but also contains facilities designed to assemble and disassemble nuclear weapons.<sup>92</sup> The Big Explosives Experimental Facility is the largest nuclear testing site in the facility and is capable of testing explosions up to 70,000 lbs of TNT. Besides its contribution to maintaining the nuclear stockpile the NNSS houses the National

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<sup>91</sup> Union of Concerned Scientists, "Sandia National Laboratories," 3.

<sup>92</sup> Union of Concerned Scientists, "Nevada National Security Site," 1-2.

Criticality Experiments Research Center, which is designed to facilitate research into the detection and monitoring of radiation for non-proliferation efforts.<sup>93</sup>

The 2014 fiscal year budget request by the NNSA reflects the site's dual role in weapons management and non-proliferation efforts, with the total budget of \$396 million divided into \$244 million for weapons activities and \$110 million for nuclear non-proliferation programs. Managing the site and its 1,900 employees is National Security Technologies, LLC, a partnership consisting of Northrup Grumman, AECOM, CH2M Hill, and Nuclear Fuel Services (a subsidiary of Babcock and Wilcox).<sup>94</sup> The NNSA has proposed using the NNSS to accelerate the disassembly of parts of the nuclear stockpile as existing dismantling facilities are overstretched. The NNSS's Device Assembly Facility is well designed for disassembly as recent expansions have made the facility capable of disposing of dirty bombs and assembled nuclear weapons from terrorists. Excess plutonium could also be stored at the Device Assembly Facility, with a DOE study estimating that the site could allow for the storage of 8,000 pits.<sup>95</sup> This would make the proposed upgraded facilities at Los Alamos for plutonium storage unnecessary and reduce the funding required to maintain plutonium storage sites at multiple facilities.

### *Pantex Plant*

The Pantex Plant is the only facility at which the NNSA officially conducts nuclear weapons assembly. While the Nevada National Security Site has recently taken

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<sup>93</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 64.

<sup>94</sup> Union of Concerned Scientists, "Nevada National Security Site," 2.

<sup>95</sup> Union of Concerned Scientists, "Nevada National Security Site," 2-3.

over some of the nuclear arsenal's disassembly programs the Pantex Plant remains the main site at which all of the components of nuclear weapons are either put together or broken down. Pantex is responsible for LEPs as well as the replacement of existing warheads and components with modernized versions.<sup>96</sup> The LEPs conducted by the Pantex Plant currently include the W87 and W76 warheads as well as multiple versions of the B61 bomb. While developing new technologies and parts for the nuclear arsenal the Pantex Plant has neglected hundreds of thousands of older unusable component parts that will never again be needed in the nuclear arsenal.<sup>97</sup> Instead of cleaning up these older components and reducing the footprint of the facility the NNSA is planning to build several additional facilities (the High Explosive Component Fabrication and Qualification Facility as well as a new high explosive pressing facility) to facilitate the continued upgrading of the high explosive parts of the nuclear arsenal.

The Pantex Plant had 3,600 employees and a \$604 million budget in 2014. The NNSA's budget breakdown indicates that essentially the entire budget (\$602 million) is allocated for weapons activities. Pantex was maintained by a branch of Babcock and Wilcox until a new contract bidding process by the NNSA awarded a management contract to Consolidated Nuclear Security, LLC (consisting of Bechtel and Lockheed Martin) for the management of both the Pantex Plant and the Y-12 site.<sup>98</sup> The NNSA has argued that this consolidation will save more than \$1 billion over the next ten years. However, the protest of two rival contractors has delayed the NNSA's contract transition for both Pantex and Y-12. Even with these management concerns Pantex has continued its dismantlement program for existing warheads. The Pantex Plant is also

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<sup>96</sup> Union of Concerned Scientists, "Pantex Plant," 2.

<sup>97</sup> Robert Alvarez, "More Bucks for the Bang," *Bulletin of the Atomic Scientists* (2015).

<sup>98</sup> Union of Concerned Scientists, "Pantex Plant," 3-4.



one of the sites that works directly with plutonium pits, and its program of reusing plutonium pits potentially providing a more environmentally-friendly avenue to refurbish warheads without requiring the production of any new pits from other labs.<sup>99</sup> Plutonium pit disassembly would be an ideal mission for Pantex to pursue with its funding instead of building facilities capable of modernizing the nuclear arsenal.

### *Kansas City Plant*

The Kansas City Plant is the only site that has seen a comprehensive modern overhaul when it finished the move from its previous location to the newly constructed National Security Campus in 2014. This shift did not affect the production responsibilities or tasks of the Kansas City Plant however, with the Plant continuing to be responsible for the production of “a wide range of mechanical, electronic, electromechanical, metal, and plastic components.”<sup>100</sup> These parts are used for LEPs of existing warheads and the replacement of specific aging components in nuclear warheads. While the plant continues to produce these new components it also houses hundreds of thousands of unusable and outdated spare non-nuclear parts of the nuclear arsenal which have not been slated for cleanup or removal.<sup>101</sup> The Kansas City Plant has no nuclear material on site and thus its 2,500 workers are exclusively tasked with building new non-nuclear components for nuclear maintenance. In 2014, the NNSA requested \$579 million for the Kansas City Plant, with \$562 million of this total allocated to weapons activities at the site. Honeywell Federal Manufacturing and

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<sup>99</sup> Civiak, et al, “Transforming the U.S. Strategic Posture,” 62-63.

<sup>100</sup> Union of Concerned Scientists, “Kansas City Plant,” 1.

<sup>101</sup> Alvarez, “More Bucks for the Bang”.

Technologies is responsible for management at the site in Kansas. Honeywell also simultaneously maintains a “Los Alamos Office” which produces detonator triggers for the nuclear arsenal.<sup>102</sup>

While the Kansas City Plant’s new location at the National Security Campus is smaller and has less of an environmental impact than the last site did, the old location has been cited as posing an environmental concern as there have been no funds allocated for cleanup of the site by the NNSA.<sup>103</sup> Additionally, the transition to a new site has brought with it an outsourcing of some manufacturing responsibilities to the commercial sector. As part of the reduction in size of the facility outsourcing is estimated to increase from 54 to 70 percent. This has drawn criticism from the Government Accountability Office which argues that outsourcing the production of sensitive components could pose higher proliferation risks because these components could be leaked to other countries or potential aggressors.<sup>104</sup> While the reduction of costs at the new National Security Campus can be applauded, the environmental impact of the old site and potential risks associated with outsourcing the manufacturing of sensitive components pose a grave threat and must be addressed.

### *Savannah River Site*

The Savannah River Site is the largest NNSA-maintained nuclear site, taking up over 300 square miles of land and employing 12,000 workers.<sup>105</sup> The site is operated by Savannah River Nuclear Solutions, LLC which consists of the Fluor Corporation,

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<sup>102</sup> Civiak, et al, “Transforming the U.S. Strategic Posture,” 67.

<sup>103</sup> Civiak, et al, “Transforming the U.S. Strategic Posture,” 68.

<sup>104</sup> Union of Concerned Scientists, “Kansas City Plant,” 2.

<sup>105</sup> Union of Concerned Scientists, “Savannah River Site,” 1.

Northrup Grumman, and Honeywell Federal Manufacturing and Technologies.<sup>106</sup> Throughout most of its history this site has been responsible for producing usable radioactive materials for the U.S. nuclear stockpile, specifically plutonium-239 and tritium. The Savannah River Site is still responsible for maintaining tritium levels in existing warheads and performs reliability tests on the tritium-injection systems that boost warhead yields. While this part of the Savannah River Site's function still contributes to NNSA stockpile maintenance the primary mission of the Savannah River Site has been environmental cleanup of its own waste products. The site houses 37 million gallons of radioactive waste produced from its past production of radioactive materials. The cleanup efforts at the site itself have already cost tens of billions of dollars and the classification of the Savannah River Site as a Superfund location indicates the severity of its environmental impact.<sup>107</sup> In 2014, the NNSA requested \$1.4 billion for the site and allocated \$1.2 billion to environmental cleanup efforts.<sup>108</sup>

The dramatic continued costs of cleanup have delayed construction of several facilities designed to convert excess plutonium to plutonium-uranium mixed oxide (MOX) fuel capable of being used in commercial nuclear reactors. The MOX Fuel Fabrication Facility is currently under construction and was originally slated for completion in 2016, but the NNSA has pushed back the date to at least 2019. Budgeting for the Savannah River Site reflects the NNSA's de-prioritization of this project: funding for the MOX facility fell from \$438 million in 2013 to \$320 million in 2014. Construction on the Fuel Fabrication Facility started in 2007 and was estimated to cost at most \$1 billion for construction with operating costs of \$156 million per year. This

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<sup>106</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 68.

<sup>107</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 69.

<sup>108</sup> Union of Concerned Scientists, "Savannah River Site," 2.

turned out to be a highly conservative estimate as costs have skyrocketed to over \$7.7 billion for construction and more than \$500 million for operating costs. Even if the facility were completed on time there are currently no commercial reactors outfitted to use the new MOX fuel, with an existing test by Duke Energy indicating that this fuel poses new safety risks to the maintenance of existing reactors.<sup>109</sup> Additionally, the fuel would create new non-proliferation risks as separated plutonium from the fabricated MOX fuel could conceivably be used to create a nuclear weapon. The NNSA has largely ignored these concerns and has instead proposed additional facilities at the Savannah River Site to facilitate the successful transition to the production of MOX fuel.<sup>110</sup> With existing cleanup and construction efforts already significantly behind schedule, however, it is highly likely that large stores of plutonium will simply remain in storage at the facility.<sup>111</sup> With existing cleanup efforts already dramatically over budget it does not make sense to continue investing in a facility that has little chance of producing a commercially viable fuel source and will only lead to insecure plutonium reserves.

### *Y-12 National Security Complex*

The Y-12 National Security Complex in Tennessee is the site at which most of the highly enriched uranium used in the U.S. nuclear arsenal is stored and processed for use in warheads. This means that Y-12 is closely involved in every life extension program with the site and its 4,600 workers already having refurbished the W87 ICBM,

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<sup>109</sup> Union of Concerned Scientists, "Savannah River Site," 2-3.

<sup>110</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 69.

<sup>111</sup> Union of Concerned Scientists, "Savannah River Site," 3.

B61-7, and B61-11 nuclear bombs as well as the W76 SLBM. While the site has multiple additional stated missions including the prevention of nuclear proliferation and down-blending of highly enriched uranium, 96 percent of the 2014 \$1.2 billion budget request by the NNSA for Y-12 was for weapons activities.<sup>112</sup> This funding allocation does not address the many thousands of canned sub-assemblies that are kept at the site without any justification for their potential future use.<sup>113</sup> Instead, approximately \$325 million was allocated for the continuing development of a Uranium Processing Facility designed to produce new weapons components to keep pace with plutonium pit production at Los Alamos.<sup>114</sup>

Despite multiple proposals to modernize the complex with facilities like the Uranium Processing Facility, Y-12 remains situated in a series of outdated facilities that have raised concerns about the security of the nuclear material stored there. In July 2012 three protestors managed to penetrate into the most highly secured part of the site and paint messages on several walls in the facility.<sup>115</sup> This event led to a reorganization of the site's security management as well as ultimately contributing to the removal of its central contractor, B&W Y-12 (consisting of the Babcock and Wilcox company and the Bechtel Corporation). Along with the Pantex Plant, Y-12 is now slated to be managed by Consolidated Nuclear Security, LLC, pending the litigation of several complaints about NNSA's contract bidding process. The inefficient transition between managing contractors has paralleled inefficiencies in the construction of the Uranium Processing Facility which has seen its projected cost of construction increase dramatically from its

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<sup>112</sup> Union of Concerned Scientists, "Y-12 National Security Complex," 1-2.

<sup>113</sup> Alvarez, "More bucks for the bang".

<sup>114</sup> Union of Concerned Scientists, "Y-12 National Security Complex," 3.

<sup>115</sup> Union of Concerned Scientists, "Y-12 National Security Complex," 3.

initially projected cost of just under \$1 billion to anywhere between \$6.5-19 billion.<sup>116</sup>

These new cost estimates have led the NNSA to abandon the initial plans for constructing the Uranium Processing Facility in favor of distributing the capabilities the facility was meant to provide to other buildings on the Y-12 site. How this is possible given the dilapidated and aging facilities on the site is as of yet unclear.

Y-12 has had a dramatic environmental impact throughout its operating years. The site has released eight times more mercury into the surrounding environment than was emitted by the entire United States in 1994 and 1995. While large sums are being spent on weapons activities and infrastructure at the site, there is little to no money allocated to fix the continued damage to the environment perpetrated by Y-12.<sup>117</sup> The effects of mercury pollution and radioactive contamination from the site's highly enriched uranium poses substantial health risks to approximately 700,000 people living within a 100-mile radius of the facility. Concerns have also been raised about the site's relative vulnerability to an attack. A security exercise conducted by the NNSA in 2007 concluded with mock attackers successfully stealing special nuclear material from Y-12.<sup>118</sup> Without substantial overhauls to the site both environmental and security concerns will make the maintenance of Y-12 a continually risky and harmful proposition.

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<sup>116</sup> Robert Alvarez, "Y-12: Poster child for a dysfunctional nuclear weapons complex," *Bulletin of the Atomic Scientists* (2014).

<sup>117</sup> Alvarez, "Y-12: Poster child for a dysfunctional nuclear weapons complex".

<sup>118</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 65-66.

## **Explaining the National Security Laboratories' Drive for Modernized Nuclear Weapons**

It is important to note that obtaining detailed and consistent information about the funding for individual labs and the NNSA is incredibly difficult due to the manner in which each new funding request is segmented and presented. Not only are the funds for each lab allocated differently in each proposal, each contractor and their corresponding lab receive different percentages of each budget allocation. Due to these funding complications a statistical analysis of the growth in each lab's funding is difficult, if not impossible, to conduct without speculation. However, all of the funding allocations indicate a disproportionate amount of spending on "weapons activities." Of the entire budget, \$6.339 billion is allocated to weapons activities, which already represents over half the total budget of the NNSA. Additionally, the construction or expansion of existing sites used to build weapons does not fall under the category of weapons activities. These activities at just Los Alamos and the Savannah River Site account for \$1 billion in expenses. Given the \$10.3 billion accounted for in the lab funding reports, weapons activities and the construction benefitting these activities accounts for over 70% of this total (\$7.339 billion). The cost of Life Extension Programs is far less than the labs are currently being allocated, indicating that much of this excess money must be going to weapon modernization and the creation of new warheads. Modernization efforts represent the most expensive component of the NNSA's activities and the funding breakdown at each lab consistently reflects an emphasis on weapons programs.

Because the labs draw so much funding from modernization programs, the labs and contractors that manage them have a vested interest in retaining their existing funds as well as obtaining more funding by arguing that modernizations are necessary for the security of the U.S. arsenal. Due to the fact that Congress currently sees funding for the labs as necessary only insofar as that funding will contribute to the nuclear arsenal, it makes sense that the labs argue that every program they pursue is essential to the security of the United States. Organization theory serves to explain the manner in which agencies pursue their own objectives separate from the overall objective of their government.<sup>119</sup> Scott Sagan applies organization theory to nuclear proliferation in order to demonstrate that militaries and organizations in charge of nuclear weapons often make decisions that merely align with that organization's objectives, rather than considering the necessity of those policies in a broader frame of deterrence.<sup>120</sup> He isolates multiple historically examples in which the military actually pushed back against the development of more secure nuclear weapons because these developments would reduce the total amount of funding for the production of larger quantities of other weapons.

While most of Sagan's work deals with the effect of organizations on the decision to acquire nuclear weapons, his insights about the inflexible nature of organizations is highly relevant to the national security labs. Without some form of new overarching objective, the National Nuclear Security Administration will continue to pursue the same goal that it always has: securing funding for the design and manufacture of nuclear weapons. The need to consistently obtain equivalent or greater

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<sup>119</sup> Scott D. Sagan, "The Perils of Proliferation: Organization Theory, Deterrence Theory, and the Spread of Nuclear Weapons," *International Security* 18.4 (1994).

<sup>120</sup> Sagan, "The Perils of Proliferation," 87.



levels of funding explains why the NNSA fights for every modernization program and attempts to create new weapons. Due to the nature of organizations to do their utmost to keep as much of their funding as possible, the best strategy for reorienting the labs is to present a new large-scale objective that would shift them away from nuclear modernization.

### **Three Labs Are More Than Sufficient to Maintain Deterrence**

While these eight sites together have long been used to maintain their respective components of the U.S. nuclear arsenal they also task thousands of brilliant minds and allocate billions of dollars towards programs that are unnecessary to maintain a secure nuclear deterrent. If the consolidation of the functions of several facilities were a feasible option then the remaining national security laboratories could be tasked with solving problems unrelated to the nuclear arsenal. In a 2009 report, the National Resources Defense Council advocated shrinking the nuclear weapons complex to a total of three sites: Los Alamos, Sandia, and Pantex.<sup>121</sup> Not only does the geographic proximity of these three sites resolve many of the security concerns associated with transporting nuclear materials over long distances, but the existing facilities at the three sites are already well situated for fulfilling the functions of other national security laboratories. Los Alamos has pit production and refurbishment capabilities as well as extensive experience with nuclear components. Sandia has manufactured non-nuclear components for nuclear weapons for many years and already collaborates closely with

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<sup>121</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 2.

Los Alamos. Pantex provides an ideal site for the testing of high explosives and the actual process of replacing outdated components in warheads to ensure their reliability.

These three facilities together could function in a continued effort to reduce the size of the U.S. nuclear stockpile while making the remaining nuclear force more secure and reliable, according to the National Resources Defense Council Report. New warheads carry with them new security concerns and questions of reliability. Maintenance programs for the existing arsenal on the other hand can increase the security features on existing warheads at a significantly lower cost than what the development of a new warhead would entail.<sup>122</sup> The National Resources Defense Council argues that Life Extension Programs should be used to reduce the total costs associated with the nuclear arsenal and that unnecessary nuclear weapons should be discarded rather than continuously modernized.<sup>123</sup> Additionally, the report suggests that a consolidation of the labs into three facilities would facilitate much better oversight of the entirety of the nuclear stockpile and minimize unnecessary funding allocations.<sup>124</sup> By 2020, the report envisions the NNSA spending only \$2.139 billion to maintain nuclear weapons, 17% of the 2015 allocation of \$12.6 billion.<sup>125</sup> This consolidation would be able to address problems with the existing nuclear arsenal and maintain the same levels of funding for these three labs given that they will need to take on many of the roles that other labs played in the LEPs for the nuclear arsenal.

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<sup>122</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 73-74.

<sup>123</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 76.

<sup>124</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 78.

<sup>125</sup> Civiak, et al, "Transforming the U.S. Strategic Posture," 123.

## **Repurposing the Labs for Climate Change Research Solves the Problem of Nuclear Modernization and Instead Benefits the U.S. and the World**

One of the largest threats facing the United States today is climate change. Top military leaders in the U.S. as well as public officials have reached a consensus on the potential for climate change to not only directly impact the U.S., but to act as a so-called “threat multiplier” that could intensify other security threats.<sup>126</sup> Large scale weather events and coastal flooding threaten cities across the U.S., and the recent surge in tropical storms along the east coast indicates that the early effects of climate change are already being felt in the U.S. While storms and coastal floods do not threaten the survival of the United States as a whole they do have drastic consequences for individual cities and areas of the country. Almost 50% of all Americans live within fifty miles of the coast and most of this segment of the population could be vulnerable to sea level rises and storms by 2040 at the latest.<sup>127</sup> Flooding and weather events also have the capacity to damage U.S. military bases located in close proximity to the coast. The 2006 Quadrennial Defense Review concluded that multiple military bases could be entirely flooded in the event of a Category Three hurricane.<sup>128</sup> These direct impacts on the U.S. alone illustrate the need for action to mitigate the coming effects of climate change.

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<sup>126</sup> Norman R. Augustine, et al, “Securing America’s Future: Realizing the Potential of the Department of Energy’s National Laboratories,” *Department of Energy* (2015).

<sup>127</sup> Joshua W. Busby, “Climate Change and National Security: An Agenda for Action,” *Council on Foreign Relations Report* (2007): 4.

<sup>128</sup> Busby, “Climate Change and National Security,” 4.

Far more worrisome for the U.S. however are the potential international ramifications of rapid climate change. The potential destabilization of Indonesia coupled with a flood of refugees to already over-populated countries like India could result in large-scale political upheaval that would dwarf the existing refugee crisis in Europe.<sup>129</sup> It is also possible that nations like China could change their political decision calculus given intensified climate impacts, prompting a readjustment in U.S. foreign policy.<sup>130</sup> Climate change will also most likely destabilize already unstable countries in Africa and prompt further conflicts that could easily draw in the U.S. or other major powers. These conflagrations would pose a national security threat to the U.S. because of the potential rise of insurgencies similar to ISIS and the collapse of existing governments. Some degree of warming is absolutely inevitable, which means that the probability of conflict is extremely high. The U.S. military currently treats these potential scenarios as posing a significant threat to the future security of the United States because U.S. involvement in any of these conflicts would bring with it enormous human and financial costs.<sup>131</sup>

These are only some of the impacts that climate change would have, but even the ones isolated above indicate a pressing need for mitigation and adaptation strategies on the part of the United States. Fortunately, the national security laboratories are very well suited to taking on a large-scale project central to U.S. security. Just as the Manhattan Project initially established the mission of the labs, a Climate Project could shift the mission of the labs away from their current trajectory of modernization towards climate mitigation technologies. The labs have already made multiple scientific

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<sup>129</sup> Busby, "Climate Change and National Security," 8.

<sup>130</sup> Busby, "Climate Change and National Security," 8-9.

<sup>131</sup> Busby, "Climate Change and National Security," 9-10.

breakthroughs of incredible importance for new climate change technologies. Advances in superconductivity, a critical component of more energy-efficient solar cells and other energy storage mechanisms, were largely due to research done by the labs in condensed matter physics.<sup>132</sup> The labs were also closely involved in the development of new high efficiency wind turbines and are currently in the process of researching a new generation of solar cells with greater capabilities.<sup>133</sup> The labs already have much of the infrastructure in place to expand research on climate change. With the funds that could be freed up by abandoning modernization programs the labs could easily position themselves as the most prominent research institutions on climate change.

One of the most promising projects in climate change research currently is carbon capture and storage, which would have the ability to actively reduce carbon in the atmosphere by storing it underground. Scientists estimate that if an effective CCS program was the only technology deployed to combat climate change given the current trajectory of emissions, it could stabilize CO<sub>2</sub> levels at their current state for 100 years.<sup>134</sup> In conjunction with emissions reductions and other technologies CCS could prevent potential future harmful warming loops that would result from the release of methane from the Arctic permafrost, as well as provide a greater time window for the development of renewable energy.<sup>135</sup> Although CCS has incredible potential, it has not received major attention or funding that would facilitate its large-scale deployment. This is in large part due to the lack of incentives for companies to conduct research on

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<sup>132</sup> Augustine, et al, "Securing America's Future," 9-10.

<sup>133</sup> Augustine, et al, "Securing America's Future," 10-11.

<sup>134</sup> Michael L. Szulczewski, et al, "Lifetime of carbon capture and storage as a climate-change mitigation technology," *Proceedings of the National Academy of Sciences* 109.14 (2012): 5185-5189.

<sup>135</sup> Szulczewski, "Lifetime of carbon capture and storage as a climate change mitigation technology".

CCS, as well as a perception that the ultimate implementation of CCS will be prohibitively expensive.<sup>136</sup>

While the Department of Energy has funded research into CCS, its funding efforts have been meager and insufficient. Between 1997 and 2008 the DoE spent just \$900 million to incentivize technological advancements in the technology. Since 2009, the DoE has spent an additional \$3.38 billion on both research as well as implementation studies, bringing the total investment in CCS to just over \$4 billion.<sup>137</sup> This sum is insufficient to incentivize widespread research into CCS as the prime technology to combat climate change. Additionally, the DoE's funding does not cover the potential costs of actually implementing the technology in the future. Many experts argue that the actual process of capturing carbon from the atmosphere would represent 70-80% of the cost of the technology, and the DoE does nothing to address this potential future cost.<sup>138</sup> To make matters worse, funding for CCS decreased by almost \$100 million from 2013 to 2014, indicating that the DoE is de-prioritizing the technology in its funding allocation. Putting existing funding in perspective, the yearly budget for fossil fuel research and development is \$125 million more than that of CCS, even though the former amplifies global warming instead of having the capacity to diminish it.<sup>139</sup>

If just the B61-12 modernization program was cut and the funds reallocated to the development of carbon capture and storage at the national security labs there would

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<sup>136</sup> Dennis YC Leung, Giorgio Caramanna, and M. Mercedes Maroto-Valer, "An overview of current status of carbon dioxide capture and storage technologies," *Renewable and Sustainable Energy Reviews* 39 (2014): 426-443.

<sup>137</sup> Patrick Falwell, "U.S. Department of Energy Investment in Carbon, Capture and Storage (CCS)," *Center for Climate and Energy Solutions* (2013).

<sup>138</sup> Falwell, "U.S. Department of Energy Investment in CCS".

<sup>139</sup> Falwell, "U.S. Department of Energy Investment in CCS".

be an additional \$11.6 billion spent on CCS.<sup>140</sup> This sum is almost three times what has been spent on developing CCS since 1997 and would even likely be able to cover the potential costs of implementing CCS. Additionally, further research into increasing the efficiency of carbon dioxide capture would have the potential to decrease the total cost of the technology by almost 50%, making implementation even more feasible.<sup>141</sup> The labs no longer involved in the maintenance of the nuclear deterrent have unique capabilities that would allow them to take on this new challenge. The Kansas City Plant, for example, has previously researched more efficient ways to store solar energy and to reduce the overall costs of energy storage. Many of the scientists employed at the plant focus on designing efficient components for use in nuclear weapons, but have also utilized this same expertise for non-nuclear applications. Freed from its attachment to the nuclear arsenal, the Kansas City Plant could become a major hub for CCS research designed to reduce the overall costs of the technology. Other labs that currently specialize in producing components for the nuclear arsenal could use their facilities to manufacture components for CCS instead, and the technology could go from its theoretical stage to implementation rapidly.

Cutting just one modernization program and repurposing the funds contained within that program could result in the implementation of one of the most promising technologies to combat climate change. If every modernization program was cut and reallocated in this way climate change research would receive a boost of several hundred billion dollars over the next decade. Researchers at the labs would be able to pursue projects that fit their area of expertise, resulting in a number of new minds in the

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<sup>140</sup> Loehrke, “Meet the Budget Busting B61”.

<sup>141</sup> Leung, et al, “An overview of current status of carbon dioxide capture”.

field of climate research as well. A large-scale shift in the mission of the labs would result in an extraordinary contribution to solving the most pressing problem facing the world. Additionally, the perception that the U.S. is shifting its efforts from nuclear modernization to climate change research has the potential to be modeled by other nations around the world. Instead of prompting other powers to build up their own arsenals, a repurposed NNSA that focuses on climate change would likely make other nations far more willing to cooperate on both arms control as well as climate change issues. As illustrated earlier, countries are proceeding with their modernization efforts because of the U.S. commitment to a modernized arsenal. If U.S. modernization was halted, other nations would most likely no longer feel a need to modernize their own arsenals for security purposes, and could re-purpose their own organizations in charge of nuclear modernization for climate change research.



## **Conclusion**

Nuclear modernization is an expensive proposition that currently serves to justify the missions of the eight national security laboratories. From the current standpoint of the NNSA, the only way to secure new funding is to propose excessive and expensive modernization programs. These costly programs serve to undermine international security. However, halting the harmful push for modernization would enable funding at the national security laboratories to be deployed in productive ways that could harness some of the nation's best and brightest scientists in collective research projects with tangible global benefits. It is neither necessary nor prudent to continue having all of the labs focus on nuclear modernization and refurbishment when three labs would be more than sufficient to maintain a stable deterrent. Consolidating the duty of maintaining the arsenal to three labs allows the other labs to utilize their existing funding for modernization efforts to pursue highly beneficial technologies such as carbon capture and storage. Greater research into technologies to combat climate change is essential if the United States is to successfully confront the impacts that climate change will have in the future.

With a shift in their organizational mission, the labs could become a force for good in the international community. Instead of artificially creating unnecessary projects to inflate their funding, the labs could use the funds that they would have spent on destructive technologies in order to develop productive and beneficial technologies. The NNSA as an organization is concerned with obtaining the funding that it needs to justify its continued organizational existence. As long as there is money that allows the NNSA to fund its labs and continue working, where that money goes to is not important

to the organization. With a complete shift in the organizational mission of the NNSA without any reduction in funding the NNSA could transition to climate change research. This would enable other nations to also shift their own efforts away from modernization and towards dealing with climate change. There is no conceivable reason that the U.S. needs eight laboratories working on the nuclear arsenal. Instead of working on programs that move the world closer to nuclear devastation, the labs should pursue research that addresses the inevitable harms of climate change.

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