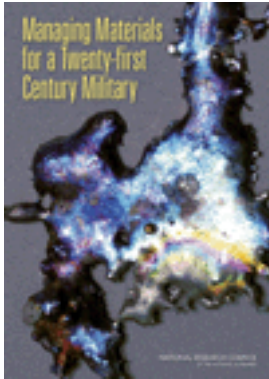


## Free Executive Summary

### Managing Materials for a Twenty-first Century Military

Committee on Assessing the Need for a Defense Stockpile, National Research Council

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*Since 1939, the U.S. government, using the National Defense Stockpile (NDS), has been stockpiling critical strategic materials for national defense. The economic and national security environments, however, have changed significantly from the time the NDS was created. Current threats are more varied, production and processing of key materials is more globally dispersed, the global competition for raw materials is increasing, the U.S. military is more dependent on civilian industry, and industry depends far more on just-in-time inventory control. To help determine the significance of these changes for the strategic materials stockpile, the Department of Defense asked the NRC to assess the continuing need for and value of the NDS. This report begins with the historical context of the NDS. It then presents a discussion of raw-materials and minerals supply, an examination of changing defense planning and materials needs, an analysis of modern tools used to manage materials supply chains, and an assessment of current operational practices of the NDS.*

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# Summary

It is a different world from when the National Defense Stockpile (NDS) was established just before World War II. The nature of the global economy has changed, not only expanding U.S. access to the international market but also increasing competition from a growing list of other countries seeking access to sometimes scarce raw materials. In the twenty-first century, the United States is faced with several asymmetric national security threats that span the globe, requiring the military to be able to respond rapidly to sudden increased demands. Defense needs are now defined in a new context that is focused on capabilities-based planning rather than on threat-based planning. At the same time, the supply of defense systems has been transformed from a government-dominated military-industrial complex to a global, dual-use, civil-military industrial complex. The U.S. military is now more dependent on civilian industry than it was 70 years ago, when the NDS was established. Civilian industry, in turn, depends increasingly on global sourcing and on overseas R&D programs and other foreign assets. Meanwhile, industrial practice of inventory control has shifted from stockpiling and holding reserves to a just-in-time, or sense-and-respond, system for managing supply chains.

In this context, the Committee on Assessing the Need for a Defense Stockpile of the National Research Council (NRC) was asked to assess the continuing need for and value of the NDS. It was also asked to discuss current defense materials needs, to reassess the necessity of stockpiling of strategic and critical defense-related materials and, if called for, to develop some general principles for any future operation and configuration.

In response to this charge, the committee reviewed previous government-sponsored studies as well as legislation pertaining to the stockpile. It analyzed the outputs of years' worth of work by the Defense National Stockpile Center and reviewed the methodologies used to develop stockpile materials requirements. Its report discusses current defense materials needs, the changes in ways of generating defense requirements and system requirements, and the dramatic changes in the global supply and availability of materials. Other policies relating to defense industrial base needs are considered, as well as other tools available to assure a continuing supply of materials.

The committee concluded based on the preponderance of evidence it considered that the operation of the current NDS is disconnected from actual national defense materials needs in the twenty-first century and from national defense strategies and operational priorities. While there have been frequent changes in law and policy governing military planning and operations, there have not been any concomitant changes in the design or operation of the NDS.

**Conclusion 1: The design, structure, and operation of the National Defense Stockpile render it ineffective in responding to modern needs and threats.**

In the committee's judgment, there remain three major threats to assuring the supply of materials critical to the national defense:

- Increased demand from around the world for mineral commodities and materials.
- Diminished domestic supply and processing capability along with greater dependence on foreign sources.
- Higher risk of and uncertainty about supply disruptions owing to the fragmentation of global supply chains.

Modern minerals supply chains to U.S. industry and indeed to global industry are characterized by outsourcing and offshoring. Reductions over time in U.S. mining operations, processing facilities, and metal fabrication operations have limited U.S. capacity for mining or processing ore, and in some cases the country is entirely reliant on foreign sources in some key minerals sectors. Much of the current content of the U.S. defense materials stockpile reflects history rather than current national security needs, and the process to assess stockpile requirements and goals does not identify specific materials needed to produce current or planned military systems and platforms. Consequently, there may be a demand for specific, high-priority, defense-related materials that is not being addressed because too little is known about materials usage.

**Conclusion 2: The Department of Defense appears not to fully understand its needs for specific materials or to have adequate information on their supply.**

Although in principle inventories of defense materials could be valuable in the current and future strategic and economic environment, the existing stockpile system is not properly designed to meet national defense materials. The system and its operation are neither timely nor based on up-to-date information. The process is episodic rather than dynamic, and the lack of data on demands for specific materials means the NDS cannot be responsive to changes in world markets in real time. There does not appear to be a strong relationship between stockpile policy and national security objectives nor is there an understanding of global supply chain management practice. The committee reports that many of the earlier conclusions and recommendations coming from one forum or another are similar to each other and to those coming from this committee. However, they were for the most part never acted on or implemented, leading the committee to the conclusion that the operation and future of the NDS have never been high on the agenda of the DoD leadership, nor do they seem to be now.

A system to ensure against disruptions to the supply of materials of defense interest would benefit from a well-defined and dynamic model that allows identification of critical materials. There remains an urgent need to improve the collection of information, both here and abroad, on the availability of these materials, without which there is no way to rationalize and motivate government intervention in the supply of these critical materials.

**Conclusion 3: A lack of good data and information from either domestic or offshore sources on the availability of materials impedes the effective management of defense-critical supply chains.**

In the committee's judgment, dependence on supplies from abroad is not per se a cause for concern. But it may become so when combined with other factors such as concentration of supply, political instability in the source regions, and greater competition for mineral resources across the globe. Twenty-first century threats to national security are different from those associated with the more familiar concepts of war and conflict of the last century. In the committee's judgment, and notwithstanding the ineffectiveness of the current configuration of the NDS, there remains a role for the federal government in the active management of the supply of materials for defense systems.

**Conclusion 4: Owing to changes in the global threat environment and changes in the U.S. industrial base, the emergence of new demands on materials supplies, the ineffectiveness of the National Defense Stockpile, and the resultant potential for new disruptions to the supply chains for defense-critical materials, the committee believes there is a need for a new approach in the form of a national defense-materials management system.**

The framework for a materials management system needs to reflect current geopolitics and take into account that U.S. defense and commercial supply chains are mutually dependent on one another and on global economic dynamics. Having considered which tools, in addition to or instead of a stockpile, could help to assure a continuing supply of materials, the committee concludes that a whole new approach is required. It found that the private sector—focused as it is on agility and efficiency and having been directly impacted by global materials' availability—has embraced the concepts of supply-chain management. Where private sector stockpiles of industrial materials or parts are deemed absolutely necessary, they are resorted to, but only sparingly.

Identifying the materials needs of the twenty-first century military, understanding the risk of disruptions in the supply chains for those materials, and planning actions to mitigate the impact of surges in requirements and unexpected shortfalls in inputs demands a systematic and coordinated policy response.

**Recommendation 1: To meet the national strategic objective of assuring the timely availability of materials necessary to maintain the national defense capabilities of the United States into the foreseeable future, the Secretary of Defense should establish a new system for managing the supply of these materials.**

The committee is recommending not just a new organizational construct or a bureaucratic answer but a totally new system approach, including appropriate policy, regulatory, and legislative changes. The new system would be based on a coordinated strategy designed to ensure the availability of critical materials to meet a well-defined and dynamic model of defense needs. Holding a materials inventory would be one of the many tools available to a defense-materials management system. More important, however, a new system would (1) assess the risks in order to make better-informed decisions on mitigating them (for example, deciding if stocks need to be held); (2) spot vulnerabilities in the supply chain and redesign it to eliminate or mitigate them before events occur; and (3) design and manage the supply chain to be more resilient to disruption. The new system will depend critically on the conduct of analyses that identify defense-specific materials needs.

Notwithstanding any future decisions by the Secretary of Defense on how to implement a new system, the committee provides some general operational principles.

**Recommendation 2: The operation of a system for managing the materials needed for national defense should be guided by the following general principles:**

- Establish an ongoing analytical process to identify materials that are critical to defense systems. The analysis should include gathering information on short-term and long-term needs for primary and secondary (component) materials. The process could include a system of annual reporting from the services and defense agencies, starting at the procurement level, which identifies strategic and critical materials and the potential vulnerabilities in their supply.
- Integrate the ongoing operation of the new system with current defense planning.
- Set a flexible policy framework that is integrated with the full set of legislation and policies governing the procurement of defense-related systems from U.S. contractors.
- Use all available tools to support and stabilize robust supply chains in the increasingly changeable and global environment for materials supply, including the holding of a materials inventory that would serve as a flexible, continuously changing buffer stock with constant and timely management for restocking and balance.
- Provide the option of partnering with private industry as well as options for outsourcing and offshoring.
- Provide an appropriate and robust information system and forecasting tools.
- Solicit advisory input from industry, academia, and other stakeholders, as appropriate, accompanied by communicating with stakeholders and the public on the general status and activities of the materials management system.
- Evaluate recycling and substitution as additional sources of key materials.
- Perform risk assessments that take into account present and future environmental constraints on some defense material availabilities.

As discussed earlier, no matter what the future holds for the supply of defense-critical materials, there is an urgent need to improve the collection of information—from both domestic and offshore sources—on the availability of materials for defense needs.

**Recommendation 3: The federal government should improve and secure the systems for gathering data and information—both at home and abroad—on the availability of materials for defense needs. It must be able to obtain accurate data on**

- The geographic locations of secure supplies of critical materials and of alternative supplies;
- The potential for market and geopolitical disruptions as well as logistical and transportation upsets and the risks posed by them; and
- The use of materials in defense applications, in the nondefense industrial sectors of the United States, and in the rest of the world's large commodity-consuming nations.

# Managing Materials for a Twenty-first Century Military

Committee on Assessing the Need for a Defense Stockpile

National Materials Advisory Board

Division on Engineering and Physical Sciences

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*Cover:* A titanium splash. Titanium is a light, strong, lustrous, corrosion-resistant metal that can withstand extreme temperatures. Titanium alloys have many uses in military systems, including in aircraft, armor plating, naval ships, spacecraft, and missiles. SOURCE: Gerald Petrak, Wright-Patterson Air Force Base.

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# Preface

In the report language for the 2006 National Defense Authorization Act, the Armed Services Committee of the U.S. House of Representatives (HASC) directed the Department of Defense (DoD) (1) to review its policy for disposing of material in the National Defense Stockpile (NDS) and (2) to determine whether the NDS should be reconfigured “to adapt to current world market conditions to ensure future availability of materials required for defense needs.”<sup>1</sup> In July 2006, in response to this request, DoD, through the Defense National Stockpile Center (DNSC) at the Defense Logistics Agency, issued a report suggesting that the National Research Council (NRC) be asked to carry out a study on the NDS.<sup>2</sup> In response, the NRC formed the Committee on Assessing the Need for a Defense Stockpile to assess the continuing need for and value of the NDS and, if needed, to develop general principles for its operation and configuration. In carrying out this charge the committee was asked to

1. Describe, drawing on previous studies of the National Academies, current national defense materials needs, taking account of the recent evolution of the domestic and global materials supply chains and the impact of growing international materials needs on materials availability.

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<sup>1</sup>Armed Services Committee of the U.S. House of Representatives, Report of the Committee on Armed Services, House of Representatives, on H.R. 1815 together with additional and dissenting views. Report 109-89, p. 477. Washington, D.C. (2005).

<sup>2</sup>U.S. Department of Defense, Report in Response to House Armed Services Committee Request on p. 477 of Report 109-89, Washington, D.C. (2006).

2. Re-assess the national need for the stockpiling and safe, secure, and environmentally sound stewardship for strategic and critical defense-related materials in the United States. In conducting this assessment the committee will consider other nations' stockpiling initiatives.
3. Recommend general concepts and scenarios for the operation of any future national stockpile that would consider the roles of government, industry, and the wider materials community in the identification of specific defense materials needs.

By NRC standards, the time available to the committee to do its work (fewer than 6 months elapsed between the committee's first meeting and this report going into NRC review) was much shorter than usual. As a result, the scope of the committee's work had to be limited to what was achievable in a comprehensive way within the expedited schedule. The committee was not able to analyze in depth specific defense materials needs, but this report does provide an outline of those needs based on the work of other committees and studies, including NRC reports (as called for in the charge), the expertise of the committee members, presentations to the committee, and information gathered by committee members during the study. While the committee began its work by considering the narrow matter of need for the stockpile, its focus evolved over the course of the study to considering the larger matter of assuring supply. Also, while the committee drew conclusions on stockpiling as one method to assure supply—the core issue in the committee's opinion—it did not have the time or resources to assess the safety, security, or environmentally sound stewardship of materials in the stockpile. These stewardship issues could be considered in any future work on the configuration of the stockpile. The committee, in fact, hopes that this study will only be a beginning and that serious consideration will be given to a more thorough, deliberate, and longer look into the important issues that remain.

The NRC populated the committee with members having a broad range of backgrounds and interests.<sup>3</sup> They came from government laboratories, large and small companies, and academia. While several members had some experience or knowledge of stockpile history and operations, the subject was a new one for a majority of the members. This was by design, and the committee embarked on the study with no preconceived ideas about the outcome.

The committee heard from representatives of DoD, the U.S. Geological Survey, the Institute for Defense Analyses, the Department of Commerce, academic institutions, industry associations, and aerospace industries. It reviewed stockpile legislation, DoD policies, past studies by the General Accounting Office, the Congressional Budget Office, and the NRC, and other reports on national defense materials needs. The full committee met twice in open session and several times by teleconference.

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<sup>3</sup>Note that members of this committee served in a personal capacity and the views they express in this report do not reflect those of their employers or any other institution with which they are affiliated.

Additionally, several members tasked with major report drafting responsibilities met twice in Washington, D.C. In both cases, the drafts were vetted by the committee as a whole. The committee then met a third and final time in plenary closed session to come to consensus on this report and its conclusions and recommendations.

While the study was under way, the NRC's Board on Earth Sciences and Resources was in the midst of a related study, on minerals and mineral products critical to industry and emerging technologies in the U.S. economy. While neither committee was privy to the other's private deliberations in closed committee sessions or draft reports, the committees did share the publicly available information they had gathered. This committee is grateful to the members and staff of the Committee on Critical Mineral Impacts on the U.S. Economy for their cooperation.

My thanks go to the committee for its extraordinary efforts to produce this report in a short time. Although members came together from a variety of professional backgrounds, the committee was united in its diligence and dedication to completing its task—a task all quickly saw as being important to the country. Overall, this was an enjoyable and educational experience. None of it would have been possible without the commitment of the NRC staff, who supported the committee's work and made it possible for the committee to adhere to its expedited schedule.

The committee worked diligently to understand the legislation, policies, and actual operation of the NDS as well as legislation and policy governing other aspects of materials supply, logistics, and the defense industrial base. Significant effort was devoted to analyzing the history of stockpile operations as they relate to defense planning. In the end, the committee was struck by the fact that despite the efforts of interested organizations and dedicated individuals in DoD and the Congress to make critical and strategic materials decisions based on sound analysis and assessment of risk, the NDS remains a low-priority activity for DoD leadership.

The committee has attempted to call attention to the dramatically different situation in which the country finds itself compared with 70 years ago, when much of the stockpile legislation and policy was originally conceived. The globalization of materials production and supply has radically changed the ability of the United States to produce and to procure materials vital to defense needs. Yet, little has been done in the face of changed materials needs in the military nor have the methods of computing stockpile requirements or the means of assuring continued supplies been adapted to reflect these changes. The committee is hopeful that this report will be the catalyst for long-awaited and much-needed action.

Robert Latiff  
*Chair*





# Acknowledgment of Reviewers

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

Jack E. Buffington, University of Arkansas,  
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John D. Morgan, U.S. Bureau of Mines (retired), and  
Subhash C. Singhal, Pacific Northwest National Laboratory.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Elisabeth M. Drake, Massachusetts Institute

of Technology. Appointed by the National Research Council, she was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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