United States Government Accountability Office

Report to Congressional Committees

June 2016

ELECTRONIC WASTE

DOD Is Recovering Materials, but Several Factors May Hinder Near-Term Expansion of These Efforts

GAO-16-576

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GAO Highlights

Highlights of GAO-16-576, a report to congressional committees

Why GAO Did This Study

DOD routinely disposes of electronics, including items such as computers, cell phones, and copiers, as well as electronics in weapon systems and other equipment. While some usable items are reused, transferred, or donated to other entities, the remaining electronic waste is sent to recyclers. Electronic waste may contain materials that can be recovered, which can reduce the need to procure them through other sources. DLA disposes of DOD's electronic waste.

Senate Report 114-49 and House Report 114-102 include provisions for GAO to review matters related to the disposal of DOD electronics and efforts to recover materials from them. This report discusses (1) the extent of DOD's electronic waste that is processed and the types of materials that are recovered from it and (2) DOD's efforts to assess potential opportunities to expand its recovery efforts and factors that could affect expansion. GAO reviewed guidance on electronics disposal, analyzed data on the amount of waste processed and materials recovered, obtained information on efforts to expand material recovery, and interviewed officials.

What GAO Recommends

GAO recommends that DLA take steps to ensure that strategic and critical materials are included in the development of DOD material declaration standards and guidance. DOD concurred with GAO's recommendation.

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What GAO Found

The Defense Logistics Agency (DLA) processes tens of millions of pounds of Department of Defense (DOD) electronic waste annually and recovers some materials from this waste, including precious metals and one material—germanium—that is being added to the National Defense Stockpile. DLA contracts with recyclers to handle DOD's electronic waste, a process that includes separating out recyclable materials and disposing of what remains. For more than 30 years, DLA has recovered precious metals from excess and surplus property, including electronic waste, for DOD's Precious Metals Recovery Program. The recovered metals are made available to DOD and other federal government agencies. During fiscal year 2016, DLA began to add germanium, a strategic and critical material recovered from night vision devices and other items, to the National Defense Stockpile. In December 2015, DLA changed its electronics disposal process and began selling electronic waste directly to recyclers, instead of paying for the processing and recovery of recyclable materials. Based on GAO's analysis and discussions with DLA officials, this new approach will likely reduce the amount of precious metals that DLA recovers but is expected to streamline the process and increase DLA's revenues.

DOD has assessed potential opportunities to recover certain materials found in its electronic waste, including rare earth elements, but a number of factors may hinder near-term expansion of its recovery efforts. These factors involve a combination of economic conditions, technological challenges, limitations on the types and amounts of materials that can be added to the National Defense Stockpile, the administrative capacity to initiate additional recovery efforts, and tradeoffs between selling electronic waste and recovering materials. Another factor that could hinder expansion of recovery efforts is that DOD does not have information on the material content of items, including the content found in electronic waste. According to DOD, current guidance does not facilitate the collection of this information from suppliers. DOD has begun to take steps toward the development of material declaration standards. A DOD study recommended that DOD coordinate with industry and other federal agencies to develop national-level material declaration standards that suppliers would follow to provide information on the material content of the items. It also recommended that DOD incorporate new material declarations standards into acquisition policies when appropriate. According to an official in the Office of the Secretary of Defense, the department is planning to take actions to develop these material declarations standards. However, the focus of this current effort is identifying materials that present potential health or environmental risks, and DLA therefore does not have reasonable assurance, consistent with federal internal control standards, that the resulting material declaration standards and guidance will also include strategic and critical materials.

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Abbreviations

DOD	Department of Defense
DLA	Defense Logistics Agency
OSD	Office of the Secretary of Defense

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June 20, 2016

Congressional Committees

The Department of Defense (DOD) routinely disposes of electronics, including items such as computers, cell phones, and copiers, as well as electronics found in ground, naval, and air weapon systems and related equipment. While some usable items are reused, transferred, or donated to other entities, the remaining electronic waste is sent to a recycler. Electronic waste may contain precious metals, such as gold, silver, or platinum; rare earth elements; or materials identified as strategic and critical.[1] The recovery of such materials from electronic waste, where feasible, can reduce the need to procure them through other sources. The Defense Logistics Agency (DLA) disposes of DOD's electronic waste.

Senate and House Reports accompanying bills for the National Defense Authorization Act for Fiscal Year 2016 included provisions that we review aspects of DOD's electronics disposal process, including efforts to recover strategic and critical materials, precious metals, and rare earth elements from electronics.[2] This report discusses (1) the extent of DOD's electronic waste that is processed and the types of materials that are recovered from it and (2) DOD's efforts to assess potential opportunities to expand its recovery efforts and factors that could affect expansion.

To determine the extent to which DOD processes and recovers materials from electronic waste, we reviewed federal guidance on the disposal of electronic assets and DOD guidance describing the process for electronics disposal and precious metals recovery. We obtained data from DLA on the amount (weights) of electronic waste processed per year from fiscal years 2013 through 2015, including electronic waste processed for precious metals recovery. We selected this timeframe because it corresponds with the first full fiscal year of the recycling

[1]Strategic and critical materials are materials that would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in sufficient quantities to meet such need. *See* 50 U.S.C. § 98h-3(1). Precious metals and rare earth elements are common classifications of metals.

[2]*See* S. Rep. No. 114-49, at 248-49 (2015); H.R. Rep. No. 114-102, at 277 (2015).

contract that DLA had in place at the time we started our review. We determined based on a data reliability questionnaire and discussions with agency officials that data on usable non-military electronics sold (excluding those items that were reused, transferred, or donated) and data on electronics that were demilitarized and destroyed were sufficiently reliable for reporting the yearly amounts of electronic waste material that DLA processed. We similarly determined that fiscal year 2015 data on electronic waste diverted to precious metals recovery also were sufficiently reliable for reporting the amount of precious metal-bearing material shipped for processing and precious metals recovered but that similar data for the prior two fiscal years were not sufficiently reliable—because DOD did not begin to systematically track the data until fiscal year 2015—and we did not report these data. We obtained information from DLA on the types and amounts of materials recovered from electronic waste. In addition, we obtained information on DLA's electronics disposal processes, including the process that existed prior to mid-December 2015 and a new process that began after mid-December 2015. We analyzed the effect of DLA's new electronics disposal process on the amount of materials recovered from electronic waste. We discussed this information and our analysis with DLA officials responsible for DOD disposal services and material recovery.

To determine the extent to which DOD has assessed potential opportunities to expand its recovery efforts, we reviewed and analyzed relevant reports submitted to Congress or congressional committees that assessed, among other things, requirements for strategic and critical materials for the National Defense Stockpile and the feasibility of recycling rare earth elements.[3] We also reviewed DLA studies that evaluated recycling opportunities for various strategic and critical materials, such as germanium, tantalum, indium, and cobalt. Based on our analysis of these reports and studies, discussions with DLA officials, and other information we obtained, we identified factors that could affect DLA's ability to expand its efforts to recover materials. In evaluating

[3]Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Strategic and Critical Materials 2015 Report on Stockpile Requirements* (January 2015) and *Strategic and Critical Materials 2013 Report on Stockpile Requirements* (January 2013). Also, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Report on Feasibility and Desirability of Recycling, Recovery, and Reprocessing Rare Earth Elements (September 2012)* and *Diversification of Supply Chain and Reclamation Activities Related to Rare Earths* (February 2014).

DLA's ability to address certain factors, we reviewed Standards for Internal Control in the Federal Government.[4] We also obtained perspectives on material recovery in the private sector by interviewing representatives from trade associations involved with electronics recycling and recovery and with metal industries. Appendix I discusses our scope and methodology in further detail.

We conducted this performance audit from June 2015 to June 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Strategic and Critical Materials and the National Defense Stockpile

The Strategic and Critical Materials Stock Piling Act provides for the acquisition and retention of stocks of strategic and critical materials and encourages the conservation and development of sources of such materials within the United States.[5] The Stock Piling Act defines strategic and critical materials as materials that would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency and are not found or produced in the United States in sufficient quantities to meet such need.[6] When acquired and stored under the Stock Piling Act, these materials are collectively known as the National Defense Stockpile. The primary purpose of the National Defense Stockpile is to decrease the risk of dependence on foreign suppliers or single sources of strategic and critical materials used in defense, essential civilian, and essential industry applications during and

[4]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

[5]*See* 50 U.S.C. § 98a(b); *see generally* 50 U.S.C. § 98 et seq.

[6]§ 98h-3(1).

immediately following a national emergency.[7] The National Defense Authorization Act for Fiscal Year 2014 authorized the recovery of strategic and critical materials for the National Defense Stockpile from excess materials made available for recovery by other federal agencies.[8]

The Secretary of Defense is designated as the National Defense Stockpile Manager by Executive Order and has delegated authority to the Under Secretary of Defense for Acquisition, Technology and Logistics under DOD guidance.[9] The Director of DLA is responsible for management of the National Defense Stockpile program.[10] The DLA Strategic Materials office was established to manage the operations of the National Defense Stockpile program, including the acquisition, storage, management, and disposal of materials.

Federal Electronics Disposal Guidance

The federal government's guidance for disposing of its electronics is based on broad goals initially set out in a 2009 Executive Order for a clean energy economy that, among other things, safeguards the health of the environment.[11] In 2011, an interagency task force established in response to the Executive Order made recommendations for reusing and

[7]For purposes of the Stock Piling Act, the term ''national emergency'' means a general declaration of emergency with respect to the national defense made by the President or by the Congress. § 98h-3(2).

[8]*See* Pub. L. No. 113-66, § 1411(a)(2) (2013) (codified at 50 U.S.C. § 98e(a)(5)).

[9]Exec. Order No. 12,626, 53 Fed. Reg. 6114 (Feb. 25, 1988); Department of Defense Directive 5134.01, *Under Secretary of Defense for Acquisition, Technology, and Logistics (USD (AT&L))*, paras. 3.12, E2.1.1.22 (Dec. 9, 2005) (incorporating change Apr. 1, 2008).

[10]Department of Defense Directive 5105.22, Defense Logistics Agency (DLA), para. 5.7 (May 17, 2006).

[11]Exec. Order No. 13,514, *Federal Leadership in Environmental, Energy, and Economic Performance*, 74 Fed. Reg. 52,117 (Oct. 5, 2009). One of the goals was to promote electronics stewardship, including by employing environmentally sound practices with respect to disposition of all agency excess or surplus electronic products. § 2(i)(iii). In 2015, Executive Order 13,693 revoked Executive Order 13,514, but contained a similar sustainability goal for agencies to follow beginning in fiscal year 2016, where life-cycle cost effective. Exec. Order No. 13,693, §§ 16(b), 3(l)(iii), 80 Fed. Reg. 15,871 (Mar. 19, 2015).

disposing of the government's excess and surplus electronics.[12] In 2012, the General Services Administration issued guidance for disposing of federal government electronics.[13] The guidance defines electronics generally as any items powered by electricity that have logic circuitry enabling them to perform their intended functions; it includes a list of items specifically targeted as federal electronic assets for disposal. The guidance encourages federal agencies to reuse functional electronic assets, transfer them to other federal agencies or schools and other educational institutions, donate them to states and eligible non-profit organizations, or sell them to the public. When it is necessary to dispose of electronic assets that are not reused, transferred, donated, or sold, the materials should be directed to recyclers that have met certification standards recognized by the Environmental Protection Agency.

DLA's Role in Disposing of DOD's Excess and Surplus Electronics

DLA administers the defense material disposition process for DOD's excess and surplus personal property, including electronics.[14] According to DOD's guidance for disposing of its excess personal property, the expected outcomes of the defense material disposition program include satisfying valid needs through extended use, permitting authorized donations, obtaining optimum monetary return to the U.S. government and, among other things, minimizing the need for abandoning or destroying property.[15] In order to reutilize excess and surplus property before initiating new procurement or repair, DOD components are to screen available excess property for those assets that could satisfy their valid needs.

[12]White House Council on Environmental Quality, the Environmental Protection Agency, and the General Services Administration, *National Strategy for Electronic Stewardship*, July 20, 2011. The federal government website on electronics stewardship references this guidance in the context of Executive Order 13,693.

[13]General Services Administration, *Disposal of Federal Electronic Assets*, GSA Bulletin FMR B-34, February 29, 2012.

[14]Generally, excess property is property under the control of a federal agency that is no longer required for that agency's needs. Surplus property is excess property no longer required by any federal agencies, as determined by the General Services Administration. *See* 41 C.F.R. § 102-36.40.

[15]Department of Defense Manual 4160.21, vol. 1, *Defense Materiel Disposition: Disposal Guidance and Procedures*, encl. 3, para. 3.a (Oct. 22, 2015).

Generally, when a military service or defense agency has identified property that it no longer needs, and there is no valid requirement for the property elsewhere within that organization, it turns the property over to DLA Disposition Services. Once excess property has been turned in, DLA Disposition Services staff enter information about the property into DLA's inventory management system—the Distribution Standard System—and its website, from which DOD components are able to screen property that could satisfy their requirements. DOD's disposal process redistributes useable items in one of three ways—by reutilizing the property within DOD or in certain other organizations through special programs, transferring the property to other federal agencies, or donating the property to state and local agencies or other organizations—before ultimately selling or destroying it if it is not claimed by a qualified organization. The redistribution of such property to other DOD components, special programs, federal agencies, and states helps to conserve the budgetary resources of those recipients.

DOD's Precious Metals Recovery Program

Under federal regulations, agencies are required to identify activities that generate precious metals, recover precious metals created from work processes, and identify equipment or materials containing recoverable precious metals.[16] DLA Disposition Services and Troop Support offices administer DOD's Precious Metals Recovery Program. This program promotes the recovery of precious metals from excess and surplus materiel and the reutilization of recovered precious metals for authorized internal purposes or as government-furnished material for use by DOD and other agencies. Other federal agencies may participate in this program, provided they have an Interagency Service Agreement with DLA. The program encompasses silver, gold, and the platinum group metals including platinum, palladium, iridium, rhodium, osmium, and ruthenium, although it most commonly recovers silver, gold, platinum, and palladium.

Rare Earth Elements

Rare earth elements appear in low concentrations in the ground and, although they are relatively abundant overall, they are difficult and costly to mine and process. The 17 rare earth elements are scandium, yttrium,

[16] *See* 41 C.F.R. § 102-40.225(a).

lanthanum, praseodymium, promethium, europium, terbium, holmium, thulium, lutetium, cerium, neodymium, samarium, gadolinium, dysprosium, erbium, and ytterbium. Rare earth elements can be classified as either heavy or light. According to the U.S. Geological Survey, heavy rare earth elements are generally less abundant and more expensive, due to their scarcity, more unique characteristics, and strong demand relative to light rare earth elements.[17]

DLA Recovers Some Materials from DOD's Electronic Waste, Including Precious Metals

DLA processes tens of millions of pounds of DOD's electronic waste annually and recovers materials from this waste, including precious metals and one strategic and critical material—germanium—that is being added to the National Defense Stockpile. DLA contracts with recyclers to handle DOD's electronic waste, a process that includes separating out and selling recyclable materials and disposing of what remains. In mid-December 2015, DLA changed its electronics disposal process and began to sell its electronic waste outright to recyclers, including some electronics that contain precious metals, instead of paying for the processing and recovery of recyclable materials as it had prior to this change.[18] Based on our analysis and discussions with DLA officials, this new approach will likely reduce the amount of precious metals that DLA recovers but is expected to increase DLA's revenues.[19] However, since the program was only implemented in December 2015, it is too early to determine the potential effects of the change, including the tradeoff between generating revenue and recovering materials.

[17]We recently reviewed DOD's management of rare earth elements and other strategic and critical materials. See GAO, *Rare Earth Materials: Developing a Comprehensive Approach Could Help DOD Better Manage National Security Risks in the Supply Chain*, GAO-16-161 (Washington, D.C.: Feb. 11, 2016).

[18]DLA does not sell all of its electronic waste. Some usable electronics are reused, transferred, and donated.

[19]DLA also recovers precious metals from non-electronic items.

DLA Processes Millions of Pounds of Electronic Waste Annually and Recovers Several Materials

During fiscal year 2015, DLA processed a total of almost 30 million pounds of electronic waste. The sources for this electronic waste fall into four main categories:

- Usable non-military electronic items that had not been reutilized, transferred, or donated during the property disposal process.[20] Prior to mid-December 2015, this electronic waste was sold to the public "as is," meaning that the items were not dismantled or processed in any way before they were sold, for example to separate various types of materials.
- Useable controlled or sensitive military electronic items that are not reutilized by other military services and require demilitarization or destruction.[21]
- Unserviceable military and non-military electronics, including some items that require demilitarization.[22] Prior to mid-December 2015, unserviceable items that did not have to be demilitarized were also destroyed.
- Usable and unserviceable electronic items known to contain recoverable precious metals such as silver, gold, platinum, and palladium.

Table 1 shows the amount of electronic waste that DLA processed in fiscal years 2013 through 2015.

[20]Usable items are items with value above their material content. Property marketed and sold as usable property returns greater proceeds than scrap property, which is valued only for its material content. For purposes of this report we refer to commercial off-the-shelf electronics as non-military electronics.

[21]Certain military equipment and controlled and sensitive items must be demilitarized or mutilated to prevent their further use for their originally intended purpose and to prevent the release of inherent design information that could be used against the United States. *See* DOD Instruction 4160.28, *DOD Demilitarization (DEMIL) Program* (Apr. 7, 2011). Certain scrap materials require mutilation (for example, defective or counterfeit property that is used in safety critical areas of systems). Mutilation is a process that renders materiel unfit for its originally intended purposes by cutting, tearing, scratching, crushing, breaking, punching, shearing, burning, neutralizing, etc. For purposes of this report we use the terms destroy or destroyed rather than the terms mutilate or mutilated.

[22]Unserviceable items generally require restoration or repair. In some instances, unserviceable items may be more economical to dispose of than to repair.

Table 1: Electronic Waste Processed by the Defense Logistics Agency (DLA) in Fiscal Years 2013 through 2015 (in Millions of Pounds)

Fiscal year	Useable, sold as is	Demilitarized or destroyed[a]	Known to contain precious metals[b]	Total processed
2013	17.5	8.5	[c]	**26.0**[d]
2014	17.0	10.3	[c]	**27.3**[d]
2015	18.2	10.8	0.9	**29.9**

Source: GAO analysis of DLA data. I GAO-16-576

[a]These weights are minus any packing and storage materials (dunnage).

[b]DLA's precious metals recovery program encompasses silver, gold, and the platinum group metals including platinum, palladium, iridium, rhodium, osmium, and ruthenium. However DLA's recovery contractor most frequently recovers silver, gold, platinum, and palladium.

[c]We determined that DLA's data for fiscal years 2013 and 2014 were not sufficiently reliable for reporting purposes because DOD did not begin to systematically track the data until fiscal year 2015.

[d]These totals do not include electronic waste that contains precious metals.

Precious metals have been routinely recovered from DOD's electronic waste

For over 30 years, DLA has recovered precious metals from DOD's excess and surplus property, including electronics. DOD's Precious Metals Recovery Program is intended to promote the recovery and reuse of precious metals from excess and surplus precious metal-bearing material. The recovered metals are refined and made available to the military services and defense agencies, DOD acquisition programs, and other federal agencies that participate in the program. The prices that DOD and other federal agency customers pay to obtain these recovered precious metals are below current market prices; customers are charged only for the metal recycling costs plus a cost recovery fee.[23]

DLA uses a precious metal recovery contractor to process precious metal-bearing scrap material. DLA anticipates shipping approximately 1 million pounds of precious metal-bearing scrap material each year for processing (i.e., recovering and refining), including electronic scrap. According to DLA, during fiscal year 2015, its contractor processed more than 900,000 pounds of electronics with precious metal-bearing material. The precious metals recovered from electronics were valued at approximately $6.4 million, which was about 87 percent of the total value

[23]According to DOD guidance, DLA will provide precious metals at recovery cost plus an authorized surcharge (for example, to cover administration, insurance, and transportation). *See* Department of Defense Manual 4160.21, vol. 2, *Defense Materiel Disposition: Property Disposal and Reclamation*, encl. 5, para. 2.e(3) (Oct. 22, 2015).

of precious metals recovered from precious metal-bearing DOD property. As of September 30, 2015, DLA had approximately 713,000 troy ounces of recovered silver and about 40,000 troy ounces of recovered gold in storage and available for issuance.[24] In the last 4 years, the Navy, DLA, and two civilian agencies (Federal Bureau of Investigation and National Aeronautics and Space Administration) have most commonly requisitioned precious metals, including more than 650,000 troy ounces of silver and more than 18,000 troy ounces of gold, to support things such as medical needs and government contractors' needs.

As part of its electronics disposal process, DOD is able to flag many electronic items that contain precious metals and divert these items to its Precious Metals Recovery Program. When a military service or defense agency location turns in an electronic item to DLA for disposal, it prepares a form called the Disposal Turn-in Document. This document should include the item's National Stock Number and precious metals indicator code, which inform Disposition Services staff whether the item contains precious metals.[25] Both the National Stock Number and the precious metals indicator code are assigned to an item when it first enters DOD's inventory. However, DLA data show that more than 70 percent of the electronic items that were turned in for disposal in fiscal year 2015 did not have a National Stock Number. According to DLA officials, these items may not have precious metals indicator codes, since the codes are associated with National Stock Numbers. However, based on their experience, Disposition Services field staff receiving these items may be

[24]As of April 2016, DLA reported that the balance of recovered silver had dropped to approximately 367,000 troy ounces while the balance of gold remained about the same at 41,000 troy ounces.

[25]National Stock Numbers are 13 digit codes that are assigned to items that are repeatedly procured, purchased, stocked, stored, issued, and used throughout the federal supply system. According to DLA, the National Stock Number is officially recognized by the United States Government, including DOD, as well as the North Atlantic Treaty Organization (NATO), and certain foreign governments around the world. National Stock Numbers are catalogued in the Federal Logistics Information System, which is managed by DLA.

able to determine by visual inspection whether they contain precious metal-bearing material.[26]

DLA is adding recovered germanium to the National Defense Stockpile

In fiscal year 2016, DLA began to add germanium recovered from certain military electronics to the National Defense Stockpile. Germanium originates as a by-product of zinc mining and comes in a variety of forms, including germanium oxides, germanium metal, and germanium powder. According to DLA, high-purity germanium is manufactured into infrared lenses for most DOD night vision technology, thermal imaging systems, and infrared tracking systems in combat vehicles. These applications are used for tracking ground targets and heat-seeking missiles and conducting nighttime counterinsurgency operations.

In June 2015, the Army awarded a 3-year contract to demilitarize night vision devices used in vehicles such as Abrams tanks, Bradley Fighting Vehicles, and various Army aircraft, and to recover the germanium. According to an Army contracting official, the night vision items being demilitarized are coming from its depots. In early 2015, the Army contacted DLA about transferring the recovered germanium to the National Defense Stockpile. According to a DLA official, as a result of a provision in the National Defense Authorization Act for Fiscal Year 2014, DOD can place materials in the National Defense Stockpile that are recovered from recycling, provided that DOD has recommended the material's acquisition for the stockpile.[27]

[26]A local stock number is assigned to an item, in lieu of a National Stock Number, in certain circumstances, such as when it is a locally purchased or manufactured item that cannot be linked to an existing National Stock Number, or it is an item that is not expected to be purchased again. However, according to officials, DLA Disposition Services allows the services and agencies to turn in many of their electronics that have been assigned National Stock Numbers under a Local Stock Number to save the submitting organizations time and ease their paperwork burdens. Further, only a portion of electronic items turned in for disposal with a Local Stock Number were originally acquired using a National Stock Number.

[27]A provision in the National Defense Authorization Act for Fiscal Year 2014 amended the Strategic and Critical Materials Stock Piling Act, authorizing the appropriate recovery of strategic and critical materials from excess materials made available for recovery purposes by other federal agencies. *See* Pub. L. No. 113-66, § 1411(a)(2) (2013) (codified at 50 U.S.C. § 98e(a)(5)). Amendments also authorized the use of the National Defense Stockpile Transaction Fund to encourage the appropriate conservation of strategic and critical materials. *See* § 1411(b)(2) (codified at 50 U.S.C. § 98h(b)(2)(D)).

DOD recommends acquiring strategic and critical materials for placement in the stockpile through a biennial materials requirements process that DLA leads. DLA's analyses of strategic and critical materials requirements in 2013 and 2015 determined that the limited U.S. germanium production capability would be unable to fully support industry needs during a national emergency and recommended stockpiling this material.[28] According to DLA's 2015 requirements report, the United States relies on imports to meet about 85 percent of its need for germanium, and more than half of this material is sourced from China.

Before the Army entered into its current germanium recovery contract, DLA performed an analysis to determine if the recovery of germanium would be cost effective. Based on its draft analysis, DLA estimated that the recovery effort could save up to $13.5 million over the 3-year contract period, depending on the total amounts recovered. According to DLA, the savings would come from reducing the need for germanium acquisitions on the open market to meet materials requirements for the National Defense Stockpile. As of May 2016, the Army contractor had recovered and transferred about 330 kilograms of germanium to DLA, which began adding this material to the stockpile during fiscal year 2016.[29] DLA expects to recover between about 700 and 10,000 kilograms of germanium during the 3-year contract period, depending on the number of Army items that are demilitarized under the contract.

The Army has recovered germanium from its excess night vision devices before. According to an Army contracting official, the Army had an earlier contract to recover germanium that ran from September 2009 to March 2013. This official stated that, under that contract, the germanium recycler recovered the materials and the Army was reimbursed for recycling the materials—in part because it was not clear at the time whether the germanium could be transferred to the stockpile—and the funds received from the recycling actions were returned to the U.S. Treasury.

[28]DOD, *Strategic and Critical Materials 2015 Report on Stockpile Requirements* (January 2015) and *Strategic and Critical Materials 2013 Report on Stockpile Requirements* (January 2013).

[29]The contractor retrieves the devices to be demilitarized from the Army; the DLA field disposition sites cannot process the germanium from the night vision devices because they do not accept any radioactive materials—such as night vision lenses that have a radioactive thorium coating.

New Electronics Disposal Process Will Likely Reduce DLA's Recovery of Precious Metals but Is Expected to Increase Revenues

In mid-December 2015, DLA changed its process for disposing of electronics and began to sell its electronics outright to recyclers, instead of paying for the processing and recovery of recyclable materials. The new approach to disposing of electronics will likely reduce DLA's recovery of precious metals. However, DLA estimated that it will receive more revenue per pound under the new disposal process than it did under the prior process. Moreover, based on our analysis of requisition rates over the past 4 years, DLA likely has enough precious metals in storage to support requisitions for most precious metals for another 4 years or more, even if no additional materials are recovered.

Prior to mid-December 2015, DLA separated out its military and unserviceable non-military electronics and paid an electronics recycler to process this electronic waste. The recycler segregated the electronic waste residue from the demilitarizing and destruction processes into like types—such as ferrous and non-ferrous metals—that were suitable for commercial recycling.[30] DLA offered these materials for sale to the public through its scrap sales contractor, who, according to officials, sold them and provided a portion of the proceeds to DLA. DLA also offered its useable non-military electronics that had not been reused, transferred, or donated during the disposal process for sale to the general public through the scrap sales contractor. According to DLA officials, proceeds from these sales were returned to the Defense Working Capital Fund.[31]

Since DLA changed its electronics disposal process in mid-December 2015, it now sells all of DOD's military and non-military electronics that are not reused, transferred, or donated during the disposal process directly to two recyclers, one located in the Eastern United States and the other in the Western United States. As a condition of sale, the recyclers are required to demilitarize or destroy all sensitive and controlled military electronics. Before title to the material may pass to the recycler, DLA

[30]Ferrous metals contain iron, and non-ferrous metals do not. Common non-ferrous metals include aluminum, copper, lead, zinc, and tin, as well as precious metals like gold and silver.

[31]DLA's operations are funded through the Defense-wide Working Capital Fund. A working capital fund is a type of intragovernmental revolving fund that operates as a self-supporting entity that conducts a regular cycle of businesslike activities. These funds function entirely from the fees charged for the services they provide consistent with their statutory authority.

must verify that the demilitarization process has been completed, and the recyclers must certify that they have destroyed the sensitive and controlled electronic waste.[32] The recyclers may resell all the useable non-military electronics they buy, as well as any residue materials they recover from the electronics they have demilitarized or destroyed, and they retain all the proceeds from these sales.[33] For example, according to an official from one of DLA's electronics recycling contractors, the spent batteries from DOD's electronic waste are sold to another firm that recovers lead, lithium, and nickel.

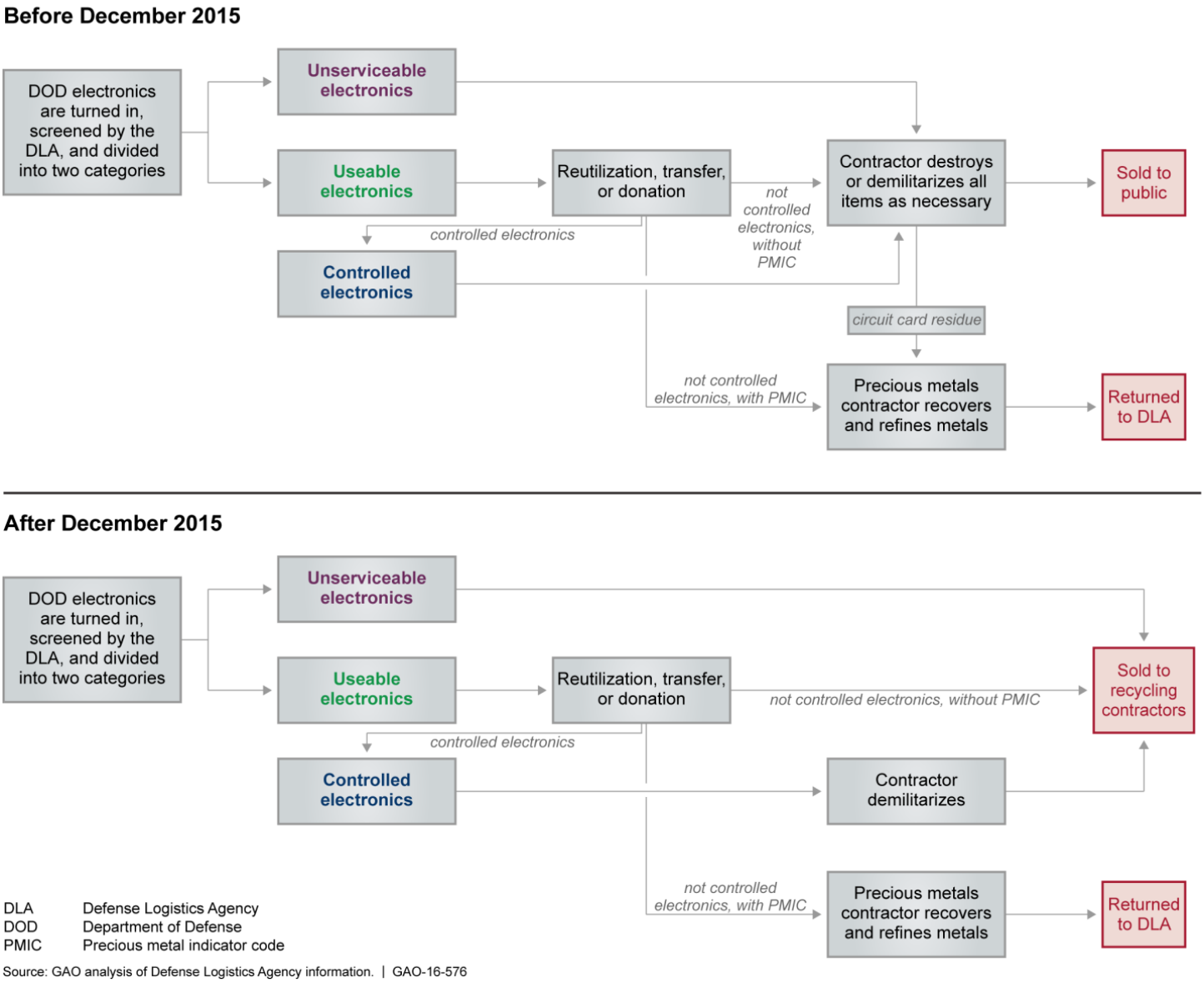
This change in the electronics disposal process will likely reduce DLA's recovery of precious metals. Under the old process, DLA's electronics recycler identified and removed circuit cards from electronics, shredded the circuit cards, and sent the residues to DLA's precious metals recovery contractor. According to DLA officials, these circuit cards are found in electronic items turned in to DLA that either (1) do not have a precious metal indicator code and therefore are not flagged for the Precious Metal Recovery Program when DLA sorts incoming material or (2) require demilitarization or destruction.[34] Under the new disposal process, DOD does not require any circuit cards from similar items that are sold to the two electronics recyclers to be sent elsewhere to recover precious metals for DOD. Figure 1 depicts DLA's electronics disposal processes before and after DLA changed to the new disposal process in mid-December 2015.

[32]For material that must be demilitarized, contractor personnel certify and government personnel verify the destruction. Material requiring demanufacturing is to be destroyed in the same manner, but with certification and verification performed by the contractor. For both categories, title transfers when the certificate of destruction is received by DLA.

[33]These useable items had previously gone through DLA's disposal process and therefore do not include items that were reused by another military service or DOD agency, transferred to another federal agency, or donated to certain state and local government agencies or other organizations before DLA sold the waste to the recyclers.

[34]Items turned in without a National Stock Number may not have a precious metals indicator code.

Figure 1: DLA's Electronics Disposal Process Before and After Mid-December 2015



Source: GAO analysis of Defense Logistics Agency information. | GAO-16-576

Our analysis of DLA data for fiscal year 2015 shows that the value of precious metals that DLA recovered would have been about 37 percent lower if the circuit cards had not been collected by the electronics recycler, shredded, and sent for processing to DLA's precious metals

recovery contractor. Specifically, in fiscal year 2015, about 327,000 pounds from a total of about 1.1 million pounds of precious metal-bearing materials processed were from circuit card residues that the electronics recycler provided to DLA's precious metals recovery contractor; about $2.7 million of the $7.3 million in precious metal recoveries that year came from circuit card residues.

As noted earlier, under the new disposal process, DLA no longer recovers precious metals from circuit cards in electronic items. However, DLA has enough precious metals in storage to support requisitions for several years, even if no additional materials are recovered. Our analysis indicates that, assuming that the pattern in the amounts of silver, gold, platinum, and palladium issued during the last 4 years (fiscal years 2012 to 2015) continues, DLA had enough precious metal materials in storage as of September 2015 to support requisitions for 4 years or more.[35] Further, DLA will continue to recover precious metals from items flagged with a precious metal indicator code, adding these metals to the existing inventory.

Under the new process, DLA officials estimate the agency will save several million dollars per year by eliminating the first contractor in the handling of its electronic waste, because it now sells its electronic waste directly to two recyclers who still do the demilitarizing and destruction actions as needed, as a condition of the sale. During the last 3 fiscal years, DLA paid a separate recycling contractor about $4.5 million per year to demilitarize and destroy its electronic waste. In addition, DLA estimates that its revenue will increase under the new disposal process. According to officials, the DLA Disposition Services sales office compared the anticipated amount of revenue under the new disposal process to revenue received under the old process and estimated that DLA would likely receive more revenue per pound through the direct sales of electronic waste to recyclers than it did under the old process. DLA estimated its combined revenue to be about 21 cents per pound under the old process; based on January 1, 2016 data, revenues were about 47 or 48 cents per pound under the new process—slightly more than double the revenue per pound that DLA had received previously. However,

[35]According to DLA officials, requisitions for silver have increased since the end of fiscal year 2015 raising some concerns about the how long the program will be able to provide this precious metal.

officials noted that they were unable to accurately estimate future revenue due to recent volatility in the metals market.[36] Further, since the program was implemented in December 2015, it is too early to determine the potential effects of the change, including the tradeoff between generating revenue and recovering materials.

DOD Has Assessed Potential Opportunities to Recover Certain Materials Found in Electronic Waste, but Several Factors May Hinder Near-term Expansion of Its Recovery Efforts

DOD has assessed potential opportunities to recover certain materials found in its electronic waste, including rare earth elements, but a number of factors may hinder near-term expansion of its recovery efforts. These factors involve a combination of economic conditions, technological challenges, limitations on the types and amounts of materials that can be added to the National Defense Stockpile, the administrative capacity to initiate additional recovery efforts, and tradeoffs between selling electronic waste and recovering materials. Another important factor is that DOD does not have information on the material content of items, including those found in electronic waste, because current guidance does not facilitate the collection of this information from suppliers.

DOD Has Assessed Potential Opportunities to Recover Certain Materials Found in Electronic Waste

Over the last several years, DOD has assessed potential opportunities to recover certain materials, including rare earth elements, germanium, tantalum, and indium, which can be found in its electronic waste. To support the Strategic Materials office, in March 2014 DOD issued a delivery order with an approximately 3-year period of performance that included a provision for research and annual reporting on opportunities for DOD to recycle, reuse, or reclaim critical and strategic materials. While this effort is not focused specifically on electronic waste, the contractor has provided recycling information for materials that may potentially be recovered from DOD's military and non-military electronic items. For example, in February 2016, the contractor provided DLA the

[36]The rates the recyclers are paying to buy DOD's electronic waste are based on a percentage of the American Metal Market #1 copper and heavy wire price. According to DLA officials, the agency resets the electronic waste per pound sale price monthly using the percentages the winning contractors bid and the price at the start of the month.

results of its assessments of potential opportunities to recycle four strategic materials, including three materials often found in electronic waste— tantalum, indium, and cobalt.[37] Tantalum is found in electronic circuit boards; indium is found in most electronics that have either a touchscreen or a flat panel display; and cobalt is found in electronics with lithium ion batteries. In summary, these studies had the following results:

- Recovery of tantalum from DOD's electronic waste may be feasible, because domestic recycling capacity exists and because tantalum is an expensive material that can be converted in different forms to be directly used in various DOD applications after it is recovered. The study did not estimate the costs to recover this material from electronic waste, but noted that a preliminary cost analysis would be beneficial.
- Recovery of indium tin oxide from liquid crystal displays that are found in electronic waste is likely not economically feasible, because no domestic recycling capability exists; therefore, DOD would need to establish and operate a recycling infrastructure. Further, liquid crystal displays must be dismantled prior to recycling, a process that is currently done by hand, and expensive chemicals are required.
- Recovery of cobalt from lithium ion batteries is possible, because recycling capability exists domestically and overseas, but it may be more expensive than other efforts to recycle these batteries, such as the conversion of old batteries into new ones of lesser quality. Additional research on the availability of lithium-ion batteries and the cost of recycling them would be necessary before recovery of this material is pursued.

DLA officials stated that additional cost analyses have not yet been done for the potential recovery of these materials but agreed that they were necessary, in addition to a more thorough assessment of the availability of these materials from DOD's electronic waste, before the recovery of this material is pursued.

In a separate effort, DLA hired a contractor in April 2014 to assess the feasibility of recovering germanium, including the availability of this material from U.S. Government waste streams and the cost-effectiveness

[37]Alion Science and Technology, *Recycling Report: An In-depth Analysis of Five Strategic Material Recycling Opportunities* (Annapolis Junction, MD: Feb. 9, 2016).

of establishing a DOD recycling program.[38] The study was completed in April 2015.[39] As noted earlier, germanium is a strategic material—found in some electronic waste—with a potential supply risk because the United States is highly reliant on imports from foreign sources. The report identified examples of germanium-containing systems waiting for disposal or demilitarization at several locations and provided preliminary information on recycling costs based on these examples. The report also found that the existing industrial base for germanium recycling is technologically mature and that no new facilities would need to be constructed for a recycling program. Based on this information, the report concluded that enough germanium can be recovered to start a pilot program. DOD's current germanium recovery program was discussed earlier in this report.

DOD also has assessed potential opportunities to recover rare earth elements. In 2012, DOD reported the results of an assessment of the feasibility of recovering rare earth elements from several end-of-life products, including neodymium iron boron magnets found in computer hard drives and other electronic devices, and reported the results in 2012.[40] DOD concluded that the recovery of rare earth elements from neodymium iron boron magnets is technically feasible but not practical due to a number of factors. These factors are discussed later in this report. Subsequently, in 2014, DOD reported the results of a study on the reclamation of rare earth elements as part of its strategy for mitigating supply risk.[41] DOD concluded that establishing a commercial-scale

[38]DLA's study was conducted independently from the Army's initiative to recover germanium, as discussed earlier in this report, and included all the military services.

[39]Umicore Optical Materials USA, Inc., *Germanium Reclamation and Recycling from Defense Applications* (April 2015).

[40]Department of Defense, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Report on Feasibility and Desirability of Recycling, Recovery, and Reprocessing Rare Earth Elements* (September 2012). DOD prepared this report in response to direction in the Conference Report accompanying the National Defense Authorization Act for Fiscal Year 2012. *See* H.R. Rep. No. 112-329, at 718 (2011).

[41]Department of Defense, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *Diversification of Supply Chain and Reclamation Activities Related to Rare Earths* (February 2014). DOD prepared this report in response to direction in the House Armed Services Committee report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2014. *See* H.R. Rep. No. 113-102, at 296 (2013).

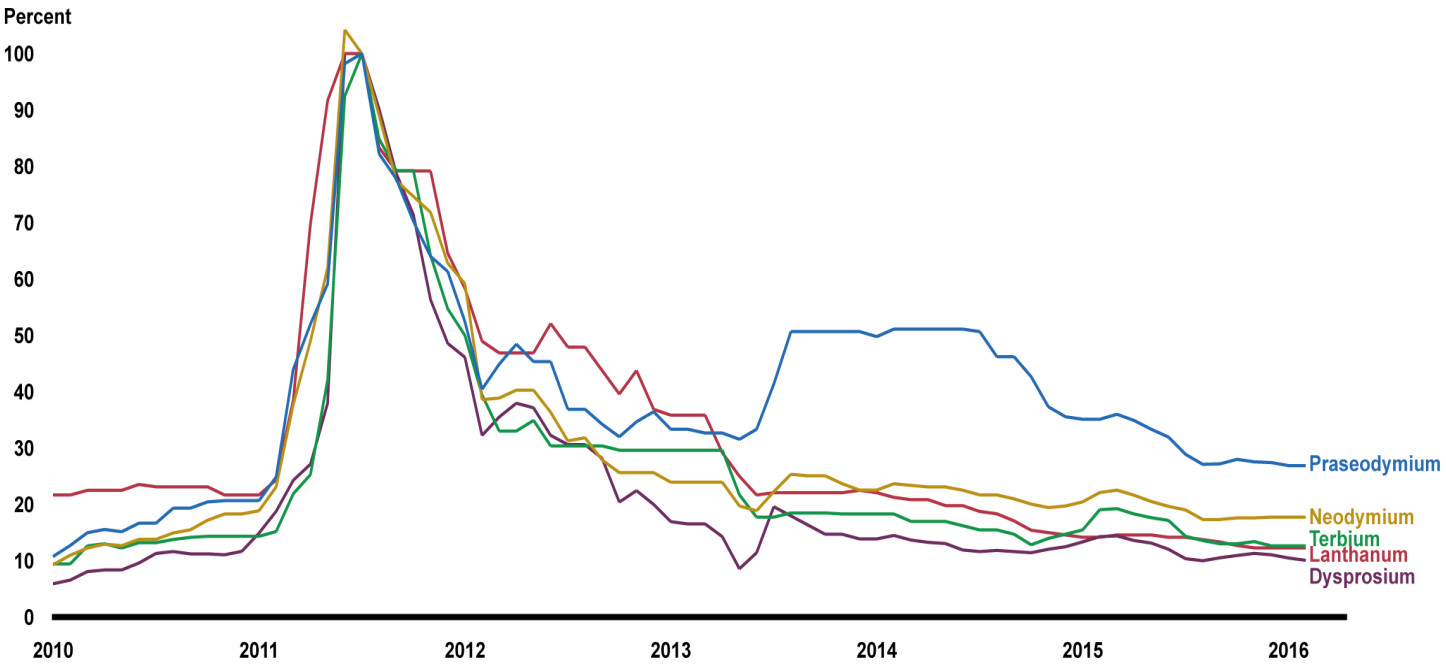
program to reclaim rare earth elements was not necessary to mitigate supply risk. DOD found that supply risk was low, stating that defense acquisition programs had not experienced any peacetime supply disruptions and no shortfalls of rare earth elements were projected to occur for these programs through 2018—even in the context of a major national emergency.

Several Factors May Hinder Near-Term Expansion of Material Recovery Efforts

Several factors may hinder DOD's near-term ability to expand recovery of materials from its electronic waste. One factor involves economic conditions, such as prevailing market conditions. For example, DOD's 2014 rare earth element report cites declining demand and prices and increased supply of rare earth materials and diversification in production as reasons why DOD is not recycling rare earth elements on a commercial scale. The 2014 report noted that supply and demand conditions have significantly improved since 2010 and 2011 both within the United States and internationally.[42] The changes that have occurred in market conditions are reflected in price decreases for rare earth elements since they spiked in 2011 (see fig. 2).

[42]According to the 2014 DOD report on diversification of the supply chain and reclamation activities related to rare earths, a combination of reduced rare earth supplies from China and a temporary sharp rise in demand for related materials in 2010 and 2011 led to price spikes in the rare earth market and showed the potential for shortages to occur in the United States.

Figure 2: Prices of Selected Rare Earth Materials as Percent of July 2011 Prices



Source: GAO analysis based on Bloomberg data. | GAO-16-576

Note: The chart shows five of the rare earth elements identified by DOD in its 2014 report, Diversification of Supply Chain and Reclamation Activities Related to Rare Earths, and compares their market prices over time as a percentage of their prices in July 2011, when the price for most of these elements reached its peak. These five elements are found in electronics.

Another economic factor is the cost of recovering items. According to a 2015 DLA study on domestic recycling opportunities for critical and strategic materials, there is currently very little strategic material recycling, possibly due to the fact that the value of the materials recovered is trivial compared to the current cost of processing them.[43] The study noted that the process to recover even a small amount of rare earth elements is cost prohibitive. It cited an example from one company where an official stated that it is extracting neodymium and praseodymium from magnets in hard drives, but this recycling is not always cost effective, because the current market cost of these materials is so low and recovery is time-consuming

[43]Alion Science and Technology, *Recycling Report: An Analysis of Strategic Material Recycling Opportunities* (Rome, NY: March 19, 2015).

due to differences in the composition of magnets. For this reason the company looks for large neodymium magnets to recycle, such as those found in windmills, electric vehicles, and large generators. An official from another company stated that recycling processors are less interested in rare earth elements than other materials, because only a small percentage is recovered. Several private sector representatives we interviewed had similar views. For example, one representative of a recycling association noted that recyclers focus on getting value from a large volume of material and therefore do not focus on materials that may be valuable—such as rare earth elements—if they are found in small quantities. Other representatives of recycling associations noted that the main reason there is not more recovery of materials from electronics is that it is not cost-effective.

Another factor, which may be interrelated with economic conditions, is the technical challenges associated with recovering materials from electronic waste. The 2015 and 2016 annual reports submitted as part of DLA's 3-year contract for the research on domestic critical and strategic material recycling opportunities noted technical challenges. For example, the March 2015 report stated that the recycling process for rare earth element-containing materials that DLA is interested in is very energy-intensive and that the products require extensive dismantling. Further, the process used to recover materials from electronic scrap tends to limit the materials recovered; rare earth elements become part of the slag and are not recovered.[44] The February 2016 report stated that lithium-ion batteries (which contain cobalt) contain a lot of chemical energy and are sensitive to pressure and temperature increases. If not handled properly, they are susceptible to fires or explosions. In addition, DOD's 2012 report stated that rare earth element content for magnets in computer hard drives is small (comprising about 0.5 percent of weight) and it requires costly and extensive dismantling because the magnet is small and part of a complex system. In addition, according to this report, most neodymium iron boron magnets are nickel plated and re-melting contaminated neodymium iron boron magnets results in lower yields and is not economical. If these

[44]Electronic scrap is often recycled in classic pyrometallurgical plants. Components are separated by type and generally shredded after which lighter weight and combustible materials, such as plastic and paper, are removed by burning or flotation. The remaining solids are heated in a furnace to remove additional unwanted volatile or decomposable content and subsequently melt the metallic elements.

magnets degrade or show signs of corrosion, it is not likely that the material will re-process correctly. According to DOD, there are also patents on some of the processes related to recycling these magnets. Finally, DOD's 2014 report stated that technologies for reclaiming rare earth elements are cost-prohibitive and immature and that there is therefore limited or no commercial-scale recycling of post-consumer waste in North America.

An additional factor involves limitations on the types and amount of materials that may be recovered for the National Defense Stockpile. DLA recommends stockpiling certain strategic and critical materials to mitigate future risk from dependence on foreign sources, or a single source, for supplies of these materials during a national emergency. As described by DOD regulations, DLA proposes acquisition of materials for the stockpile in a yearly plan that is subject to approval by Congress and subsequent authorization of funding.[45] For example, the National Defense Authorization Act for Fiscal Year 2014 authorized DLA to use up to $41 million for the acquisition of six critical and strategic materials.[46] DOD's 2014 report on Stockpile Operations noted that, prior to this, authority to acquire new materials for the stockpile had not been provided for over 20 years. According to DLA officials, if DLA initiates a recovery program to obtain materials for the stockpile, it cannot continue to recover the material beyond the amount authorized unless there is a change in the amount needed for the stockpile.[47] Depending on the amount of materials required for the stockpile, this constraint could affect the economic feasibility of recycling as a means to obtain materials for the National Defense Stockpile. DOD has proposed an amendment to the Stockpile

[45]*See* DOD Regulation 7000.14-R, *Financial Management Regulation*, vol. 4, ch. 4, para. 040605.A (May 2009). Funding authorization may be in the form of new appropriations, an authorization to spend from the available balance of the National Defense Stockpile Transaction Fund, or from sales proceeds from authorized disposals. *Id.*

[46]*See* Pub. L. No. 113-66, § 1412 (2013) (50 U.S.C. § 98d note). Section 1412 authorized DOD to make the purchases during fiscal years 2014-2019, using amounts from the National Defense Stockpile Transaction Fund. The six materials were ferroniobium, dysprosium metal, yttrium oxide, cadmium-zinc-tellurium substrate materials, lithium-ion precursors, and triamino-trinitrobenzene and insensitive high explosive molding powders.

[47]Under the act, the quantity of any material in the stockpile may be changed as provided by law or by the stockpile manager 45 days after notifying Congress in writing. *See* § 98b(c). According to DLA officials, DLA has not used the stockpile manager's authority to adjust the quantity of material in the stockpile.

Act that, according to the Department, would allow for the recovery and sale of strategic and critical materials that are not in short supply, with the proceeds to be used for future purchase of needed strategic and critical materials.[48]

DLA's administrative capacity may also be a factor in its ability to expand near-term recovery efforts. Officials in DLA's Strategic Materials office told us they are focused on the two ongoing recovery programs involving germanium and rhenium.[49] The officials stated that it took considerable effort on their part to initiate these programs and that it may be at least a year before they have the capacity to expand their program. However, DLA is taking some steps in this area. A DLA official stated that they are evaluating proposals for a Small Business Innovation Research Initiative for Rare Earth Recycling. This initiative is focusing on technology that can be used for commercial electronic waste material recovery. Also, they are continuing to expand their germanium recovery by starting programs at three additional locations—one in the Army and two in the Navy.

Another factor affecting the expansion of recovery efforts is DLA's decision to sell DOD's electronic waste to recyclers. As discussed earlier in this report, the decision by DLA Disposition Services to sell electronic waste, generating increased revenues, will likely reduce the amount of precious metals it recovers from shredded circuit card residues. Similarly, if the DLA Strategic Materials office were to decide to expand the recovery of materials for the National Defense Stockpile, DLA would have to divert items containing these materials from the waste now being sold to its recyclers. Diverting items from the waste stream could reduce the value of the waste sold to recyclers, and DLA may not be able to continue generating the same levels of revenue from the sale of electronic waste. Therefore, DLA may need to make tradeoffs between selling electronic waste and recovering materials.

[48]This proposal was sent to Congress on April 12, 2016 for consideration in the National Defense Authorization Act for Fiscal Year 2017.

[49]According to a DLA official, the rhenium program involves processing rhenium from aircraft engine fan blades (not electronics).

DOD Does Not Collect or Maintain Information on the Material Content of Electronics

In addition to the factors discussed above, another important factor affecting DOD's ability to expand recovery efforts is that it does not have information on the material content of items because, according to DOD, current guidance does not facilitate the collection of this data from suppliers. In its acquisition process, DOD does not collect or maintain data on most of the material content found in military and non-military items—including electronic items that eventually become electronic waste. Standards for Internal Control in the Federal Government states that effective information and communication are vital for an entity to achieve its objectives. Management should design a process that uses the entity's objectives and related risks to identify the information requirements needed to achieve the objectives and address the risks.[50]

DLA and OSD officials stated that the department does not have information on the material content of the items it buys, a factor that affects its ability to recover materials from items at the end of their life-cycle. This factor became evident when DLA assessed the recovery of germanium. DLA's contractor for this study reported that it could not develop an overall estimate of the amount of germanium available for recovery from weapon systems because it was difficult to locate items that contained this material. More specifically, the contractor found that (1) many program offices do not have more than a basic knowledge of the material composition of their products and largely rely on prime contractors and major subcontractors to supply this information and (2) DLA tracks items by National Stock Number and a brief description of the item and little or no additional material content information.

DOD has found that it does not have information on the material content of electronics because current guidance does not facilitate the collection of this information from suppliers when items are acquired and does not require the tracking of materials throughout the life-cycle of the items. According to DOD, although there are some guidance documents that cover the capture of limited material content information, most are targeted at only a portion of a product's life-cycle.[51] For example, according to a DOD study on the life-cycle of beryllium-containing

[50]GAO-14-704G.

[51]The life-cycle of an item includes the raw material acquisition, production, use, maintenance, and disposal phases.

materials, no DOD-specific written policies, procedures, or programs were found to address the tracking of beryllium-containing materials as strategic, critical materials during fabrication, acquisition, use, and maintenance.[52] Further, the study noted that although there are several guidance documents regarding end-of-life management practices designed to conserve beryllium as a strategic and critical material, high temperature alloy, or critical alloy, there is not much awareness of this guidance at the installation and workplace level; therefore, beryllium-containing materials are not being consistently segregated and managed to be recycled.

DOD has begun to take actions to address this weakness. Specifically, the Office of the Assistant Secretary of Defense for Energy, Installations and Environment, in conjunction with the Emerging Contaminants Governance Council,[53] tasked a contractor to perform a gap analysis of existing policies and procedures related to capturing complete material content information and also to conduct a feasibility study of options for identifying material content of items procured for DOD. The results of the gap analysis and feasibility study were briefed to the Council in December 2015.

The gap analysis identified four common gaps that limit the collection and sharing of material content information. These gaps were a lack of a clear policy status, insufficient data requirements and standards, lack of a full life-cycle approach, and inadequate information technology. The gap analysis concluded that there should be (1) a highly visible and enforceable OSD policy with specific requirements that suppliers provide complete material content information; (2) an ongoing program with designated responsibilities for organizations such as DLA; and (3) a data management system capable of capturing, leveraging, and reporting that

[52]Beryllium is used in a variety of defense-related components, including pressure-responsive devices, current-carrying springs and connectors, bushings and bearings, equipment housings, optical instruments, infrared sensors, and x-ray windows.

[53]The Emerging Contaminants Governance Council is a DOD council that endorses risk management actions for materials with evolving science or regulations that present potential high risks to the Department of Defense mission capabilities, personnel, or business functions. It meets on an ad-hoc basis depending on evolving risks. At its May 2014 meeting, the Emerging Contaminants Governance Council endorsed a risk management action to conduct a Gap Analysis and Feasibility Study on identifying material content of items.

information to users across the life-cycle of each item. The purpose of the feasibility study was to look at options, such as hazardous material standards, for fully capturing material content. The study concluded that it is not currently feasible for DOD to centrally collect these data and recommended that DOD coordinate with industry and other federal agencies to develop national-level material declaration standards that suppliers would follow to provide information on the material content of the items. It also recommended that DOD incorporate new material declarations standards into DOD acquisition policies when appropriate. According to an OSD official, the department is planning to take actions to develop these material declarations standards.

Steps taken to implement these recommendations and capture additional material content on the items DOD buys could also have positive implications for DLA's ability to expand its material recovery efforts at the end of an item's life-cycle. DLA has a representative on the Emerging Contaminants Governance Council; however, because the focus of the Council is on identifying content information for materials that present potential health or environmental risks, DLA does not have reasonable assurance that the resulting standards and guidance will also include content information for strategic and critical materials. An official from the DLA Strategic Materials office told us that additional information on the material content of items, including electronics, would benefit DLA's material recovery efforts.

If DOD cannot readily identify the material content of its electronics, it will be difficult to expand strategic and critical material recovery efforts, if needed, to mitigate supply disruptions. Without knowledge of material content, DLA cannot identify and segregate like materials into waste streams from which to recover the strategic materials. This knowledge would also be beneficial to risk management activities to mitigate supply disruptions, because if a strategic and critical material were to become unavailable, DOD likely would not know which of its systems' or items' supply chains might be affected.

Conclusions

DLA is recovering some materials from DOD electronic waste and has reviewed potential opportunities to recover additional materials. Recovering materials, where feasible, can reduce the need to procure these materials through other sources, but a number of factors may hinder near-term expansion of recovery efforts. These include economic conditions, technical challenges, limitations on adding materials to the National Defense Stockpile, DLA's administrative capacity to initiate new

efforts given its focus on ongoing recovery programs, and trade-offs between selling electronic waste and recovering materials. In addition, DOD's expansion of material recovery from electronic waste is hindered because DOD does not have information on the material content of items, including the content found in electronic waste. According to DOD, current guidance does not facilitate the collection of these data from suppliers. DOD has begun to take steps toward the development of material declaration standards that suppliers would follow, along with changes in DOD acquisition guidance, to provide information on the material content of the items. However, the focus of this effort is identifying content information for materials that present potential health or environmental risks, and DLA therefore does not have reasonable assurance that the resulting standards and guidance will also include content information for strategic and critical materials.

Recommendation for Executive Action

To provide greater assurance that material declaration standards under development by the Emerging Contaminants Governance Council include strategic and critical materials, we recommend that the Secretary of Defense direct the Director, Defense Logistics Agency, to take steps to ensure that strategic and critical material needs are included in the development of department-wide material content declaration standards and any associated changes in guidance.

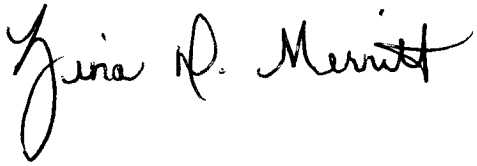
Agency Comments and Our Evaluation

In commenting on a draft of this report, DOD concurred with our recommendation. DOD's comments are reprinted in appendix II. DOD also provided technical comments, which we incorporated into the report as appropriate. DOD stated that the Emerging Contaminants Governance Council will work with industry in a joint effort to develop a national material content declaration standard. Specifically, DOD staff have initiated discussions with government and industry counterparts and proposed a workshop to outline the actions needed to develop the standard. DOD stated that it concurs that strategic and critical materials must be included in any material declaration standard. DOD did not provide an estimated completion date, stating that this was contingent on the availability of other parties to meet and the time needed to reach consensus. The steps outlined in DOD's comments, if implemented, will meet the intent of our recommendation.

We are sending copies of this report to appropriate congressional committees, the Secretary of Defense, and the Director, Defense

Logistics Agency. In addition, this report will be made available at no charge on the GAO website at http://www.gao.gov.

Should you or your staff have any questions concerning this report, please contact me at (202) 512-5257 or merrittz@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.



Zina D. Merritt
Director
Defense Capabilities and Management

List of Committees

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Chairman
The Honorable Jack Reed
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Thad Cochran
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The Honorable Richard Durbin
Ranking Member
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Committee on Appropriations
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The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Rodney Frelinghuysen
Chairman
The Honorable Pete Visclosky
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Appendix I: Scope and Methodology

To determine the extent to which the Department of Defense (DOD) processes and recovers materials from electronic waste, we reviewed federal guidance on the disposal of electronic assets and DOD guidance describing the requirements for electronics disposal and material recovery.[1] We obtained data from the Defense Logistics Agency (DLA) on the amount (weights) of electronic waste processed per year from fiscal years 2013 through 2015, including electronic waste processed for precious metals recovery. We selected this timeframe because it corresponds with the first full fiscal year of the recycling contract that DLA had in place at the time we started our review. The data included total weights of usable electronics that were not reused, transferred, or donated to other entities and were disposed of; total weights of electronic waste that were demilitarized and destroyed; and total weights of electronic waste diverted to precious metals recovery. We determined, based on a data reliability questionnaire and discussions with agency officials, that these data were sufficiently reliable for reporting the yearly amounts of electronic waste material that DLA processed. We similarly determined that fiscal year 2015 data on electronic waste that was diverted to precious metals recovery also were sufficiently reliable for reporting the amounts of precious metal bearing material processed and precious metals recovered, but we determined that this data for the prior two fiscal years were not sufficiently reliable because DLA did not begin to systematically track the data until fiscal year 2015.Therefore, we did not report fiscal year 2013 or 2014 data.

We obtained information from DLA officials on the types and amounts of materials recovered from electronic waste. We also obtained information from the Army regarding its prior germanium recovery contract. We also obtained information on DLA's electronics disposal processes,[2] including the process that existed prior to mid-December 2015 and a new process

[1]During the course of our audit, we relied on two primary sources for guidance on DOD's disposition practices. The first was August 1997 DOD Manual 4160.21-M, *Defense Materiel Disposition Manual*, which implemented the requirements of the Federal Property Management Regulation and other laws and regulations as appropriate, as they apply to the disposition of DOD's excess, surplus, and foreign excess personal property. On October 22, 2015, DOD released an updated four-volume DOD Manual 4160.21-M, *Defense Materiel Disposition Manual*, which, in general, clarifies aspects of DOD's disposition process while maintaining the essential structure of the program.

[2]DLA guidance we relied on included DLA's DRMS Instruction 4160.14, *Operating Instructions for Disposition Management*.

that began after mid-December 2015. With assistance from DLA officials, we created flowcharts depicting the processes used to handle various types of electronic waste before disposal is completed. We also analyzed the effect of the new disposal process on the recovery of materials. Specifically, we calculated the percentage of the electronics waste stream used for precious metal recoveries in fiscal year 2015 that contained circuit cards as a source material, and we calculated the percentage value of precious metals recovered in fiscal year 2015 that came from circuit cards. We also reviewed the balances of the recovered precious metals, including silver, gold, platinum and palladium, that DLA held at the end of fiscal year 2015 and compared those amounts with the quantities requisitioned from DLA during the prior 4 fiscal years to determine the effect a reduction in recoveries of precious metal from circuit cards would have on the amount of these metals available from DLA, assuming that the pattern in the amounts of silver, gold, platinum, and, palladium issued during the last 4 years (fiscal years 2012 to 2015) continues. We discussed this information and our analysis with DLA officials responsible for DOD disposal services and material recovery.

To determine the extent to which DOD has assessed potential opportunities to expand its recovery efforts, we obtained and reviewed relevant reports submitted to Congress or congressional committees that assessed, among other things, requirements for strategic and critical materials for the National Defense Stockpile and the feasibility of recycling rare earth elements.[3] We also obtained and reviewed DLA studies that evaluated recycling opportunities for various strategic and critical materials, such as germanium, tantalum, indium, and cobalt. Based on information in these reports and studies and discussions with DLA officials, we identified factors that could affect DLA's ability to expand its efforts to recover materials. To evaluate DLA's ability to address certain factors, we reviewed Standards for Internal Control in the

[3]Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, *Strategic and Critical Materials 2015 Report on Stockpile Requirements* (January 2015) and *Strategic and Critical Materials 2013 Report on Stockpile Requirements* (January 2013). Also, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, *Report on Feasibility and Desirability of Recycling, Recovery, and Reprocessing Rare Earth Elements (September 2012)* and *Diversification of Supply Chain and Reclamation Activities Related to Rare Earths* (February 2014).

Federal Government.[4] Finally, we obtained perspectives on material recovery in the private sector by interviewing representatives from trade associations involved with electronics recycling and recovery and with metal industries.

We conducted work or contacted officials at DLA; the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics; the Departments of the Army, Air Force, and Navy; and private sector companies and other organizations involved with electronics recycling or material recovery (see table 2).

Table 2: Organizations and Agencies Contacted During Our Review

Organization or agency
Under Secretary of Defense (Acquisition, Technology and Logistics)
Office of the Assistant Secretary of Defense (Logistics and Materiel Readiness) – Supply Chain Integration
Office of the Assistant Secretary of Defense (Research and Engineering)
Office of the Assistant Secretary of Defense (Energy, Installations and Environment)
Office of the Deputy Assistant Secretary of Defense (Manufacturing and Industrial Base Policy)
Defense Logistics Agency (DLA)
DLA Headquarters
DLA Troop Support
DLA Disposition Services
United States Army
Army Materiel Command
Army Research Laboratory
United States Air Force
Air Force Research Laboratory
United States Navy
U.S. Naval Research Laboratory
Private sector companies and other organizations
Umicore USA Inc.

[4]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: September 2014).

Organization or agency
Sabin Metal Corporation
Regency Technologies
Global Electronic Recycling
Consumer Technology Association.
National Center for Electronics Recycling
Institute of Scrap Recycling Industries
Green Electronics Council
Technology Metals Research, LLC

Source: GAO. | GAO-16-576

We conducted this performance audit from June 2015 to June 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Comments from the Department of Defense

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
3500 DEFENSE PENTAGON
WASHINGTON, DC 20301-3500

LOGISTICS AND
MATERIEL READINESS

JUN 2 2016

Ms. Zina Merritt
Director, Defense Capabilities Management
U.S. Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Ms. Merritt:

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report, GAO-16-576, "ELECTRONIC WASTE: DoD Is Recovering Materials, but Several Factors May Hinder Near-Term Expansion of These Efforts," dated May 13, 2016 (GAO Code 100130). Detailed comments on the report recommendation are enclosed.

Sincerely,

Gary J. Motsek
Acting Principal Deputy

Enclosure:
As stated

GAO DRAFT REPORT DATED MAY 13, 2016
GAO-16-576 (GAO CODE 100130)

"ELECTRONIC WASTE: DOD IS RECOVERING MATERIALS, BUT SEVERAL FACTORS MAY HINDER NEAR-TERM EXPANSION OF THESE EFFORTS"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATION

RECOMMENDATION: To provide greater assurance that material declaration standards under development by the Emerging Contaminants Governance Council include strategic and critical materials, GAO recommends the Secretary of Defense direct the Director, Defense Logistics Agency, to take steps to ensure strategic and critical material needs are included in the development of department-wide material content declaration standards and any associated changes in guidance.

DoD RESPONSE: Concur. The Department's Emerging Contaminants Governance Council agreed that the Department will work with industry in a joint effort to develop a national material content declaration standard. OASD(EI&E) staff have initiated discussions with government and industry counterparts and have proposed a workshop to outline the actions needed to develop the standard. The Department concurs that strategic and critical materials must be included in any material declaration standard. Estimated completion date is contingent on the availability of other parties to meet and the time needed to reach consensus.

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

Zina D. Merritt, (202) 512-5257 or merrittz@gao.gov

Staff Acknowledgments

In addition to the contact named above, Thomas Gosling (Assistant Director), David Hubbell, Linda Keefer, Joanne Landesman, Amie Lesser, Katrina Pekar-Carpenter, Janine Prybyla, Michael Shaughnessy, and Jack Wang made key contributions to this report.

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