



DEFENSE LOGISTICS AGENCY

AMERICA'S COMBAT LOGISTICS SUPPORT AGENCY



DLA Strategic Materials NDIA – E2S2

Strategic Material Supply Mitigation
Initiatives within DLA – Strategic Materials

David Hardy

May 24, 2012

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Definitions of critical and strategic

The SMPB Executive Secretary in it's meeting on December 12, 2008 detailed definitions for the following terms:

- **Strategic Material**
 - 1) A material which is essential for **important** defense systems.
 - 2) A material which is **unique** in the function it performs.
 - 3) A material for which there are **no viable alternatives**.
- Material Critical to National Security ("**Critical Material**")
 - 1) A material for which the Department of Defense **dominates** the market for the material.
 - 2) A material the Department's full and active involvement and support **are necessary** to sustain and shape the strategic direction of the market.
 - 3) A material (for which) there is significant and **unacceptable risk** of supply disruption due to vulnerable U.S. or qualified non-U.S. Suppliers.



The List of Strategic Materials Should Be Dynamic and Relevant

1

H

Hydrogen

1.0 2.1

2

He

Helium

3

Li

Lithium

6.9 3.8

4

Be

Beryllium

9.0 1.6

11

Na

Sodium

22.9 0.9

12

Mg

Magnesium

24.3 1.2

19

K

Potassium

39.1 0.8

20

Ca

Calcium

40.1 1.0

37

Rb

Rubidium

85.5 0.8

38

Sr

Strontium

87.6 1.0

55

Cs

Cesium

132.9 0.7

56

Ba

Barium

137.3 0.8

87

Fr

Francium

223 2.7

88

Ra

Radium

226.0 2.8

21

Sc

Scandium

44.9 1.3

22

Ti

Titanium

47.9 1.5

23

V

Vanadium

50.9 1.6

24

Cr

Chromium

52.0 1.6

25

Mn

Manganese

54.9 1.7

26

Fe

Iron

55.8 1.8

27

Co

Cobalt

58.9 1.9

28

Ni

Nickel

58.7 1.9

29

Cu

Copper

63.5 1.9

30

Zn

Zinc

65.4 2.0

31

Ga

Gallium

69.7 2.0

32

Ge

Germanium

72.6 2.2

33

As

Arsenic

74.9 2.3

34

Se

Selenium

78.9 2.4

35

Br

Bromine

79.9 2.8

36

Kr

Krypton

83.8

37

Rb

Rubidium

85.5 0.8

38

Sr

Strontium

87.6 1.0

39

Y

Yttrium

88.9 1.3

40

Zr

Zirconium

91.2 1.4

41

Nb

Niobium

92.9 1.6

42

Mo

Molybdenum

95.9 1.8

43

Tc

Technetium

98.9 2.0

44

Ru

Ruthenium

101.1 2.2

45

Rh

Rhodium

102.9 2.3

46

Pd

Palladium

106.4 2.4

47

Ag

Silver

107.9 2.5

48

Cd

Cadmium

112.4 2.7

49

In

Indium

114.8 2.7

50

Sn

Tin

118.7 2.8

51

Sb

Antimony

121.8 2.9

52

Te

Tellurium

127.6 3.0

53

I

Iodine

126.9 3.5

54

Xe

Xenon

131.3

55

Cs

Cesium

132.9 0.7

56

Ba

Barium

137.3 0.8

57

La

Lanthanum

138.9 1.0

58

Ce

Cerium

140.1 1.1

59

Pr

Praseodymium

140.9 1.1

60

Nd

Neodymium

144.2 1.2

61

Pm

Promethium

145.0 1.3

62

Sm

Samarium

150.4 1.3

63

Eu

Europium

152.0 1.4

64

Gd

Gadolinium

157.3 1.4

65

Tb

Terbium

158.9 1.4

66

Dy

Dysprosium

162.5 1.5

67

Ho

Holmium

164.9 1.5

68

Er

Erbium

167.3 1.5

69

Tm

Thulium

168.9 1.5

70

Yb

Ytterbium

173.0 1.7

71

Lu

Lutetium

175.0 1.7

72

Hf

Hafnium

178.5 1.8

73

Ta

Tantalum

180.9 1.8

74

W

Tungsten

183.8 1.9

75

Re

Rhenium

186.2 2.0

76

Os

Osmium

190.2 2.2

77

Ir

Iridium

192.2 2.2

78

Pt

Platinum

195.1 2.3

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Au

Gold

197.0 2.4

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Mercury

200.6 2.4

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Am

Americium

243.0 2.8

96

Cm

Curium

247.0 2.8

97

Bk

Berkelium

247.0 2.8

98

Cf

Californium

251.0 2.8

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Es

Einsteinium

252.0 2.8

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Fm

Fermium

257.0 2.8

101

Md

Mendelevium

258.0 2.8

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No

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10.8 2.0

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Tungsten

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Rhenium

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Strontium

87.6 1.0

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Ag

Silver

107.9 2.5

48

Cd

Cadmium

112.4 2.7

49

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Indium

114.8 2.7

50

Sn

Tin

118.7 2.8

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Antimony

121.8 2.9

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Te

Tellurium

127.6 3.0

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I

Iodine

126.9 3.5

54

Xe

Xenon

131.3

55

Cs

Cesium

132.9 0.7

56

Ba

Barium

137.3 0.8

57

La

Lanthanum

138.9 1.0

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Ce

Cerium

140.1 1.1

59

Pr

Praseodymium

140.9 1.1

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Nd

Neodymium

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61

Pm

Promethium

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62

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Samarium

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Lu

Lutetium

175.0 1.7

72

Hf

Hafnium

178.5 1.8

73

Ta

Tantalum

180.9 1.8

74

W

Tungsten

183.8 1.9

75

Re

Rhenium

186.2 2.0

76

Os

Osmium

190.2 2.2

77

Ir

Iridium

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Pt

Platinum

195.1 2.3

79

Au

Gold

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Hg

Mercury

200.6 2.4

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Tl

Thallium

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Californium

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257.0 2.8

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Mendelevium

258.0 2.8

102

No

Nobelium

259.0 2.8

13

B

Boron

10.8 2.0

14

C

Carbon

12.0 2.5

15

N

Nitrogen

14.0 3.0

16

O

Oxygen

16.0 3.5

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F

Fluorine

18.9 4.0

18

Ne

Neon

20.2

19

Na

Sodium

22.9 0.9

20

Ca

Calcium

40.1 1.0

21

Sc

Scandium

44.9 1.3

22

Ti

Titanium

47.9 1.5

23

V

Vanadium

50.9 1.6

24

Cr

Chromium

52.0 1.6

25

Mn

Manganese

54.9 1.7

26

Fe

Iron

55.8 1.8

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Co

Cobalt

58.9 1.9

28

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Cu

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Zn

Zinc

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144.2 1.2

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Promethium

145.0 1.3

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Sm

Samarium

150.4 1.3

63

Eu

Europium

152.0 1.4

64

Gd

Gadolinium

157.3 1.4

65

Tb

Terbium

158.9 1.4



Standard Materials



Specialty Materials



"New" Materials

The Periodic Table is not all inclusive! It includes only elements!

4 Managed by UT-Battelle
for the U.S. Department of Energy

Strategic Materials Sustainability -Lowden





Shortfall Shortage Mitigation Strategy

- Improved **re-use** and **recycling** of materials through targeted end of life actions and in-process **conservation** of materials.
- **Understanding** of the current levels of recycling and re-use of defense materials and components.
- **Identification of the barriers** to greater levels of recycling and re-use, particularly for materials identified as strategically important to defense or critical in terms of supply risk.
- **Development of programs and applicable policy** solutions to mitigate strategic and critical materials issues.

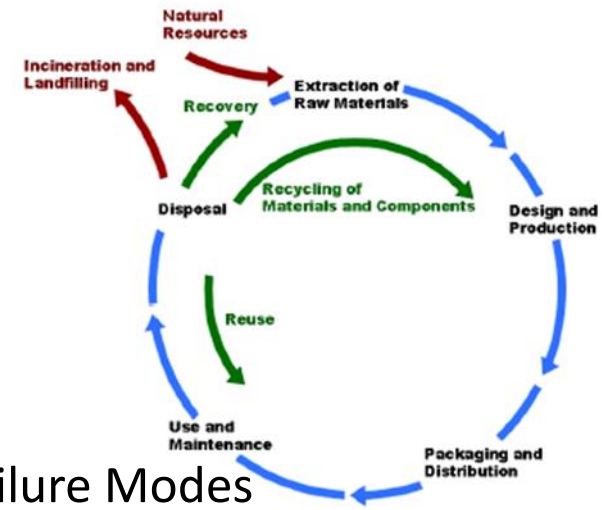


Shortfall Shortage Mitigation Strategy

RECYCLING (will require coordinated effort)

Efficiency (reduce front-end scrap)

- Near Net Shape Processing
- Intimate Processing
- **END of Life (long-term recovery)**
 - Life cycling modeling
 - Predictive Means to Evaluate Multiple Failure Modes
- **Material(s) Identification**
 - Multi-tiered Supply Chain
 - Bar-Coding, Labeling, Inscribing
 - Data Codes into FLSS/NSNs



Life Cycle Diagram



Materials Processing



End-Items



DLA Strategic Materials

- Programs listing (8)
 - DLA and Strategic Materials Management (Materials Identification)
 - Beryllium (DoD and DOD applications, Bulk Billet Upgrade) (Materials Conservation, Recycling)
 - Germanium (Billet Wafering and recovery) (Upgrade, Conservation)
 - Insensitive munitions (TATB, Fuze Molding Powders) Recycle
 - Super-Alloys (Rhenium, then Cobalt and Nickel) Possible Recycle Program
 - Magnetics (Master Alloy Buffers) Conservation
 - Rare Earths (Policy, Industrial, Dy, Er, Eu, Gd, Nd, Pr, Y)
 - Titanium (armaments and recovery policy) Conservation



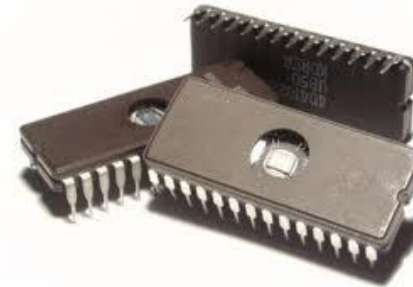
Strategic Materials Management



Clothing & Individual Equipment



Platforms, Guidance and Control



Microcircuits



Batteries



Strategic Material Management System

DLA SM and DLA R&D

- Development of Statement of Work to Design Program (Draft Under Review)
- Intra-Agency Program which will involve many DLA Staff Offices (J3, DLA DS, DLA R&D, etc.), plus Interface with DoD (Services)

Portfolio: SCM

Sponsor: Mr. Luis Villarreal

Customer: Buyer/Industry

Implementer: J-74/MTS/Deloitte

Strategic Plan/Director's Guidance Link: Warfighter Support Enhancements and Business Process Refinements

Project sends, receives, or stores data (IT): Yes

J-6 POC (if applicable): Patrick Mulcahy (IA)

R&D Mgr: N. Seiling 804-279-5120

Program Manager's Assessment: S2MS included in IBMS/WICAP IT Dashboard – Baseline to deploy NLT 3/31/2010

Problem: Raw materials represent a critical path constraint to defense manufacturers. Availability directly impacts an industry's capability to surge production during war or to meet other surges in demand (e.g., grounded weapon system for safety requiring 100% replacement). Additionally, the Defense National Stockpile Center (DNSC) as manager of the Strategic Material Security Program (replaced National Defense Stockpile) requires identification of strategic materials required to support DoD Weapon Systems, supply chain risks and actions to mitigate the risks.

Objective: Develop tool set for functionality for the Worldwide-web Industrial Capability Assessment Program (WICAP) to collect and analyze material production requirements and market intelligence (availability, capacity, product lines, closings, expansions, feeder stocks), assess supply chain risks and identify mitigation actions.

Project Costs: (\$ in Millions)

	FY Year 1	FY Year 2	FY Year 3	FY Year 4	FY Year 5	Key Performance Indicators	Threshold	Objective	Actual
R&D	0.800 ¹	0.500	0.250			Companies Registered	50	200	0
Other	1.250 ^{2,3}	0.080	0.080			Part-to-Material Mapping	50,000	140,000	0



DLA R&D Conclusions for DLA Strategic Materials

R&D Challenge:

- Automated capture of commercial and engineering data into the Federal Logistics Information System (FLIS)

R&D Objectives:

- Improve the quality, speed, and cost of logistics data acquisition and management
- Effectively map the Strategic Materials within Defense Weapons Systems
- Develop the process and tools for managing acquisition, reutilization and disposition decisions related to Strategic Materials content



Plans:

- Provide tools to military activities via DoD Engineering Drawing & Modeling Group
- Initiate projects in technical data mining

Methodology:

- Leverage capabilities of DLA Logistics Operations R&D (J335)
- Parametric search tools for product characteristics (DLIR)
- Logistics and technical data sharing with OEMs (DLIR, WSS)
- Mapping technical characteristics (Casting & Forging)
- Develop decision-based and risk assessment tools (WSS, SCM)
- Conduct business process analysis and roadmaps (WSS)



Beryllium

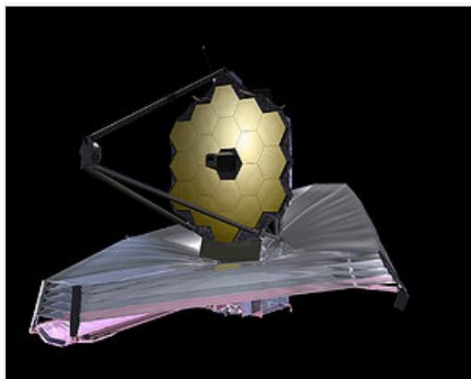
■ Pure Be and high Be composites

- Light weight, stiff (guidance, optics, missiles, etc.)
- Good thermal properties (electronic packaging)
- Transparent to x-rays (medical, etc.)
- Neutron reflector (weapons, reactors, etc.)

■ Two thirds of Beryllium Products' revenue (90% of the Be by weight) is defense and space

■ Major commercial applications

- x-ray windows (medical, industrial)
- detectors (scientific)
- acoustics (speakers)
- optical scanners
- semiconductor processing equipment



3/4 view of JWST from the "top" (opposite side from the Sun).



Beryllium IMU



Beryllium Sunshade and Optics



■ Fission test reactors

- Reflectors
- Detectors

■ Fusion reactors

- JET
- ITER

■ DoE Weapons

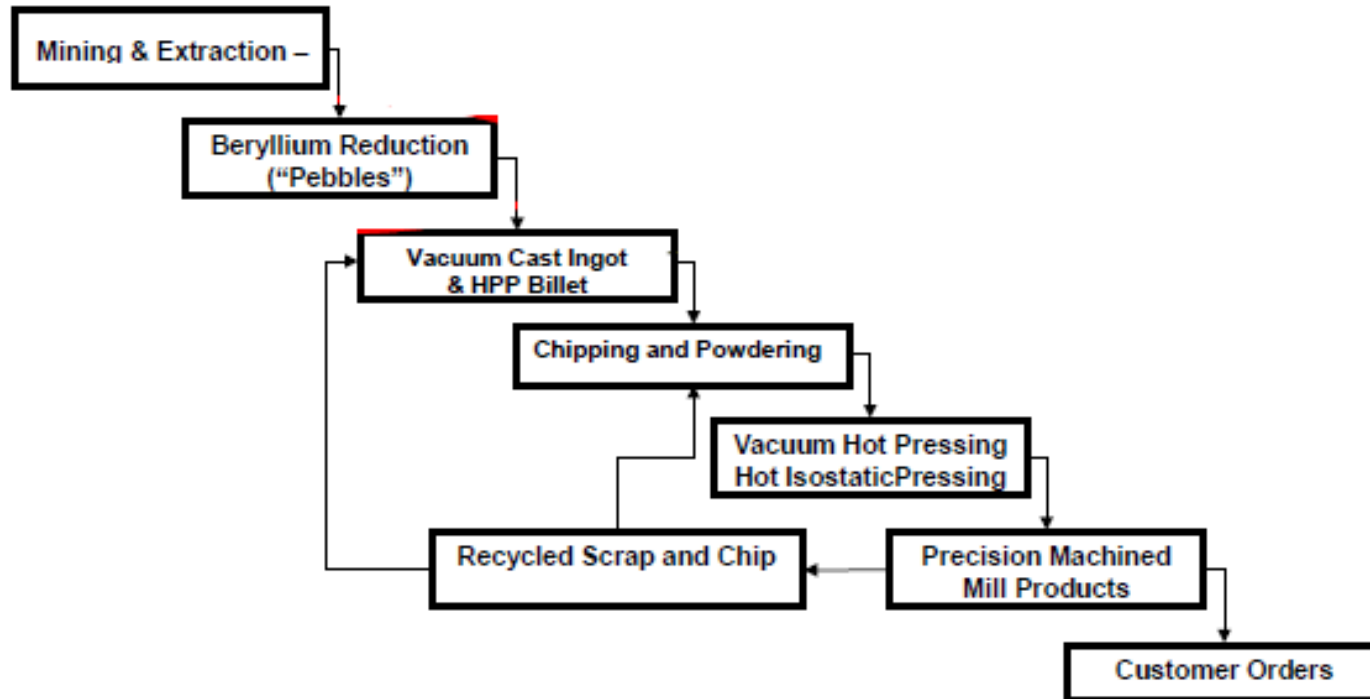
■ Nuclear fuels

- Braze materials
- Additives (developmental)





Manufacturing Process for Be Metal Products



NOTE: Recovery of scrap presents a technology issue. As oxide will readily form, especially on fines, thus severely limiting ability to place back into process. Ideally, material is sourced to support near-net forming, thus minimizing waste and scrap up-front rather than design for recovery at product end-of-life.



Beryllium NDS Upgrade

FY 2017 – desired Beryllium Stockpile Upgrade complete

FY 2015 - program review possible contract award

FY 2015 - Apr program review possible contract award

FY 2014 - program review possible contract award

FY 2013 - program review possible contract award

FY 2013 – Qualification of quality sample deliveries

FY 2012 - initial contract award (pilot volume quantities)

FY 2012 – Final Review of Offers

FY 2012 - Issue Solicitation

Nov 2011 - Issue RFI

Oct/Nov 2011 – Prepare and Coordinate SOW within team

Jun/Oct 2011 – Review requirements & prepare/distribute Determination documents

May 2011 - FY11 and FY12 AMPs signed, Jul 2011 – FY11 Authority received for sales only

Feb 2011 – Initial upgrade proposal presented by Materion

Feb 2011 – FY12 AMP submitted, requesting authority for Be upgrade

Feb 2010 – FY11 AMP submitted, requesting authority for Be sales and upgrade

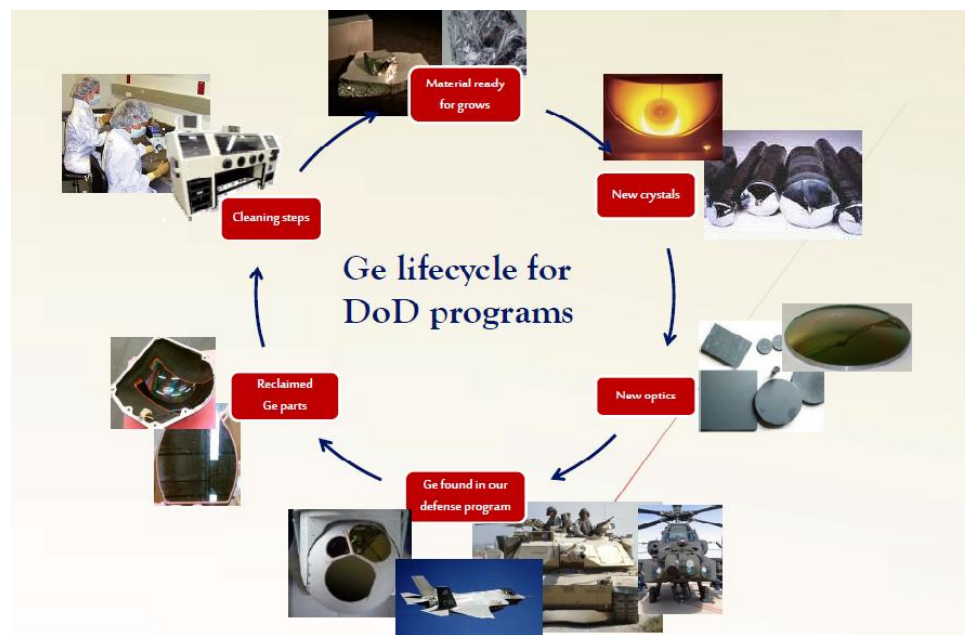
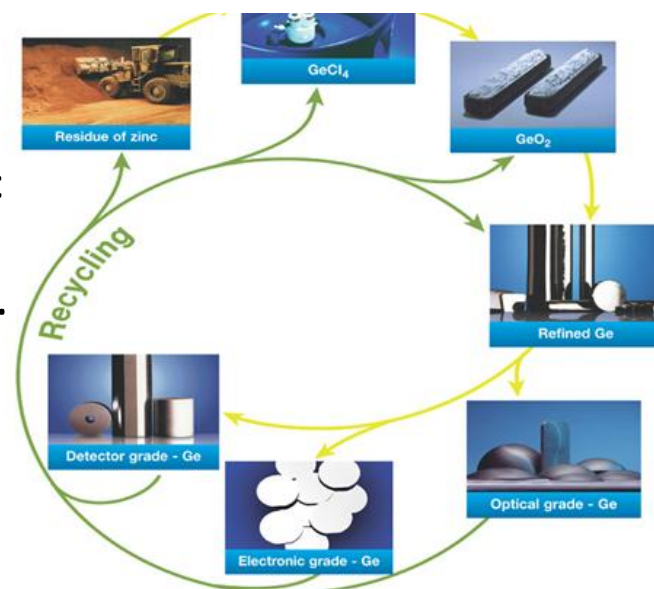
Project Scope:

Upgrade Be NDS to yield 50 tons total of 5 different HIP powders and nominal 20 tons of bulk metal

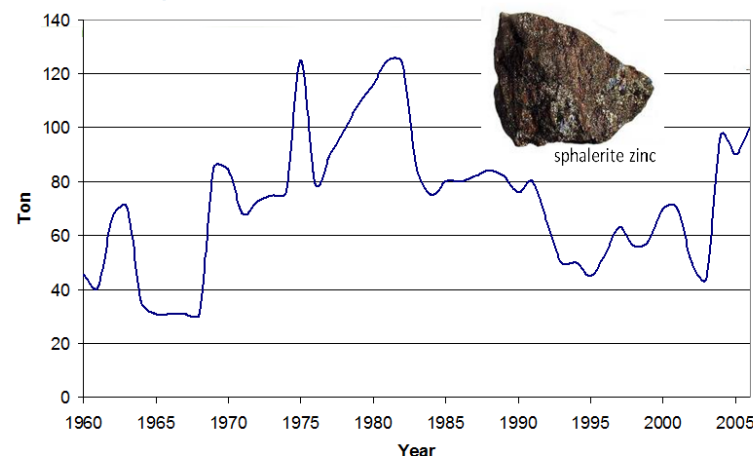


Germanium

- In 2007 35% of the demand was met by recycled germanium
- DoD requires Ge for wide range of products and applications such as “windows” and photovoltaic (PV) application (both terrestrial and space)
- Processing material further “up” supply chain, i.e. oriented doped wafers, conserves material while positioning stockpile to respond to DoD requirements, due to needs (crisis or natural disaster)



Ge world production



Sources of data are the U.S. Bureau of Mines and the U.S. Geological Survey—Minerals Yearbook (MYB); Mineral Commodity Summaries (MCS) and Commodity Data Summaries (CDS)



On-Going - Product End-of-Life Recycling (DCMO)

Department of Defense Germanium Reclaim/Recycling Program

Decommissioned infrared (IR) transmission windows which are used for target imaging are recycled. These windows, of various sizes and curvatures are found in FLIR components, such as laser guidance, missile targeting and night-vision/thermal imaging/sensing devices used in many system platforms, such as M1 tanks, Apache helicopters, AF fighter jets, ships, etc.



Any hazardous coats, such as Thorium must first be removed from recovered scrap/reclaimed materials. However accomplished, the scrap is refined for regrowth of new crystal boules/ingots for use in new IR components for platform applications.





Germanium Billet Upgrade (Material Conservation)

* Approved Project Scope:

Phase 1 – FY 12 Upgrade 3,000 kg of NDS metal

to unfinished, epi-ready space certified wafers

Phase II - FY 14 Purchase 3,000 kg of 5N metal for the NDS



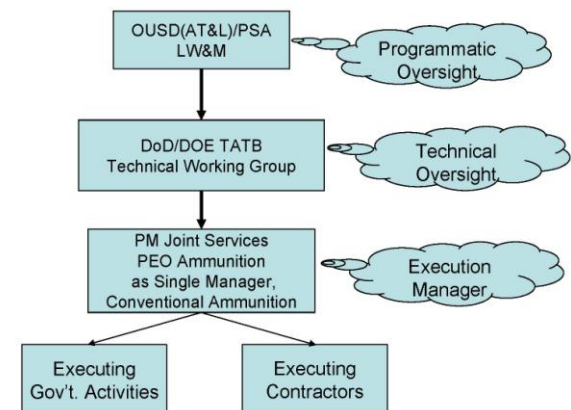


1,3,5-Triamino 2,4,6-Trinitrobenzene (TATB) Facilitization, A Joint DOD / DOE Collaborative Program

(Establish Process and Reclaim/Recycle Munitions)

- Memorandum of Agreement was executed on TATB in 2009, between the Department of Defense (DOD) and the Department of Energy (DoE). The MOA established a collaborative Program effort to develop and qualify a domestic production source for 1,3,5-Triamino 2,4,6-Trinitrobenzene (TATB) explosive.
- The Agreement facilitated by the Office of the Secretary of Defense, Land Warfare and Munitions (LW&M), was established between the Departments of Army, Navy and Air Force, and the National Nuclear Security Administration, DoE to produce TATB via the Benziger Synthesis Process.
- DLA SM to support efforts for Insensitive High Explosive (IHE) Triaminotrinitrobenzene (TATB) Based Molding Powders used for PBXN-7, PBXW-14, PBX-9502 and LX-17-series

TATB Project Governance





Insensitive High Explosive Munitions (IHE)

1,3,5 trichlorobenzene (TCB), triaminotrinitrobenzene (TATB) and Molding Powders for PBXN-7/PBXW-14/PBX-9502/LX-17 series Fuzes

TATB Facilitization Program	FY2009				FY2010				FY2011				FY2012				FY2013			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Department of Energy (DoE) Provides Services TATB from Strategic Reserves																				
DoD Acquisition Strategy Approved			Sep 2009 ▲																	
Process Development Contracts Awarded				Nov 2009 ▲								JULY								
Design & Facilitization Contracts - BAE Only												▲								
Gate Review and Plant Construction																				
Debug and Proveout/ EM Qualification																				
Transition to Production																				▲
Reclamation and Qualification Program																				
DOD Decision to Proceed and Reclamation Contract Award to BAE												JAN 2011 ▲								
Department of Energy (DoE) Provides PBX-9502 and LX-17 for Reclamation													September 2011 ▲							
Establish Reclamation Process, Prove-out and Formulate N-7/W-14																				
Testing and Shipping																				
DOD Qualification Testing																				
Reclamation Process Available to DOD																				



DLA Strategic Materials is Active Member :

- **Interagency – Interservice Working Group** on Insensitive High Explosive Materials
- **Interservice Working Group** on Energetic Materials

Active DLA Strategic Materials Programs On-Going:

- **Funding** in-place for NNSA and DoE services TATB certification/qualification
- **Determinations complete** with intent to bring TATB and Molding Powders into the stockpile.

Program Accomplishments:

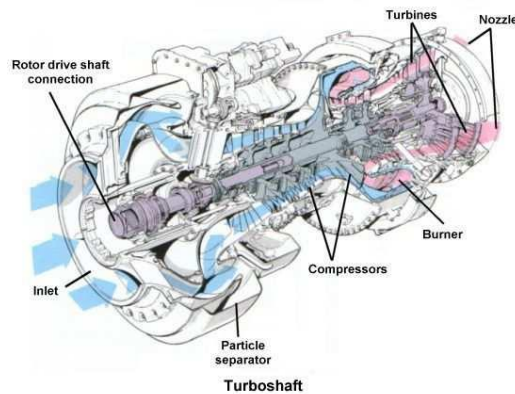
- Title III Installation completed and reclamation process developed by BAE Industries at HAAP.
- TATB pilot run using “reclaim” performed end-of-month April 2012.
- Process and results reported by DOD/DOE Working Group at JANNAF Conference, 30 April – 4 May 2012.
- Commercial effort reported on by BAE at NDIA IMEM, 14 – 17 May 2012.

DLA Strategic Materials Program Objective:

- Establish temporary **Vendor-Held Buffers for TCB and TATB**, (Eliminating requirement to re-introduce domestic TCB manufacture).
- **Acquire TATB and Molding Powders** for Sequestered Stockpile
- **Fund** Certification and Qualification Requirements for DoD and DOE uses.

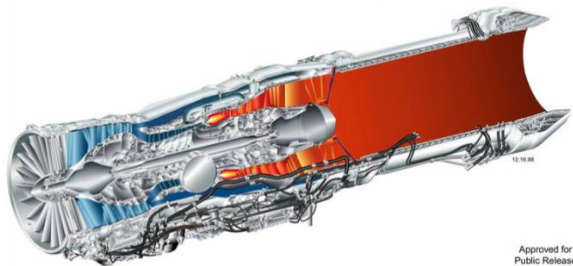


Super-Alloys (Rhenium, then Cobalt and Nickel) Recycle Potential

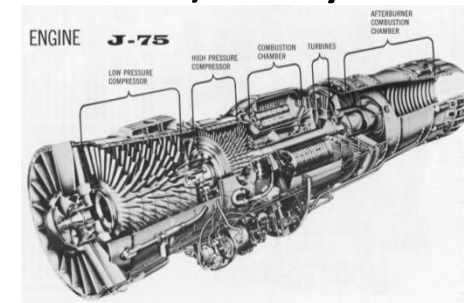


Refractory metal alloys include Rhenium, Nickel, Cobalt, Niobium, Molybdenum and Tantalum based alloys are used in Jet engines and rocket motors.

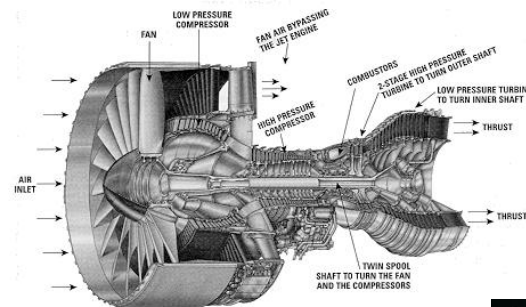
Joint Strike Fighter
F-35 Lightning II Propulsion
F135 Conventional Take-Off Landing



Approved for
Public Release

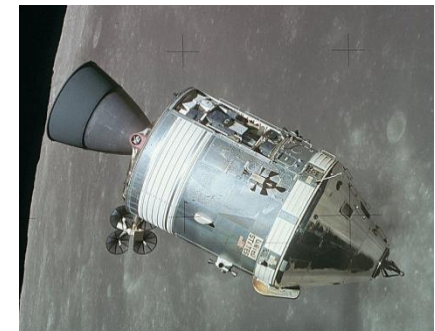


The twin-spool type Pratt & Whitney J-75 turbojet engine with afterburner as used in the F-105B Thunderchief



This is a Pratt & Whitney PW4084 turbofan

Pilot end-of-life 3-year metals 2008-2011, recovery program at Tinker Air Force Base, from engines focused on Nickel alloys netted funds to cover cost-of-program, vendor profit and allow General US Treasury deposits.



Apollo CSM with the dark rocket nozzle made from niobium-titanium alloy



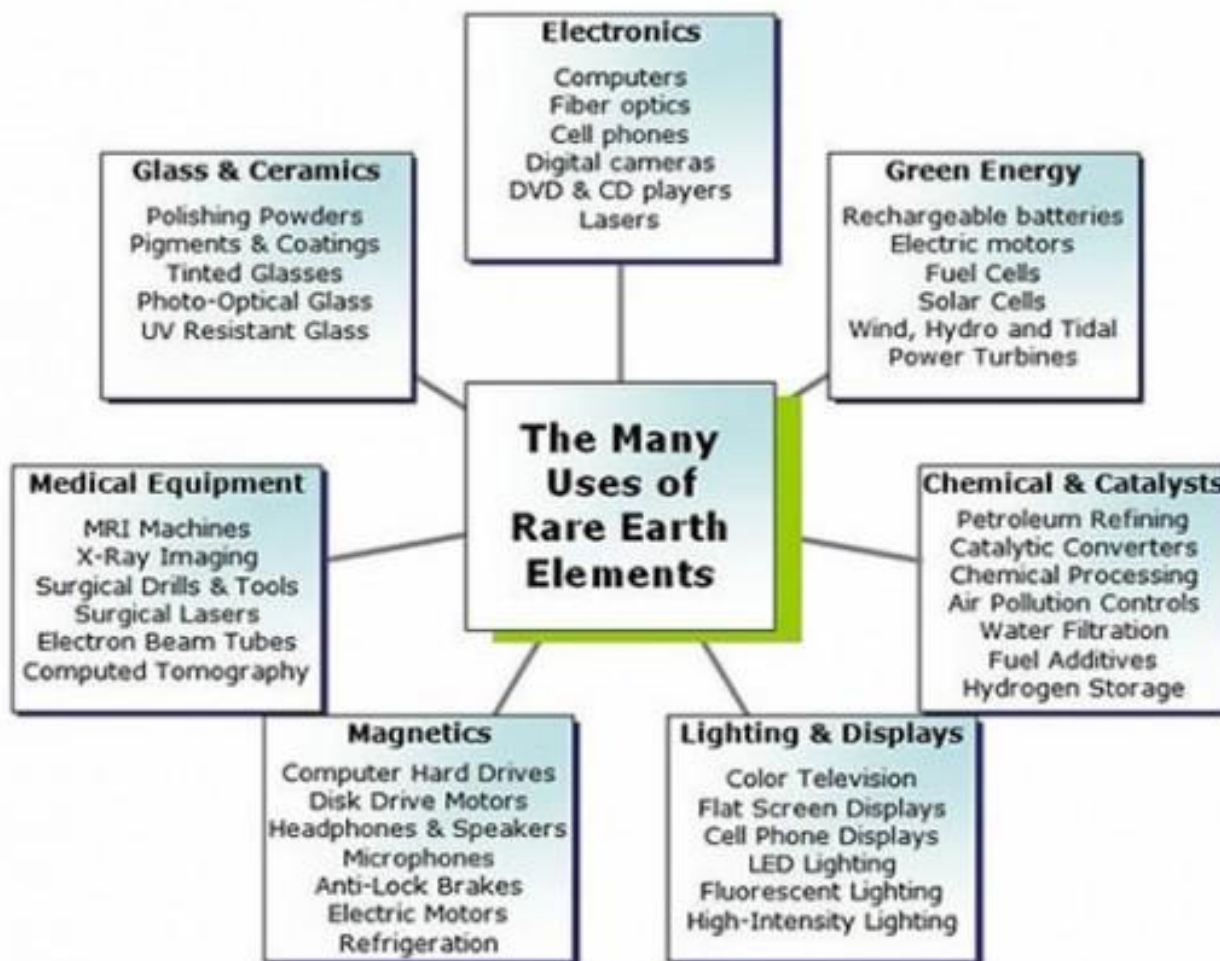
S&CM Recovery & Reuse Programs

- 2003-2008 – Rhenium costs and OEM lead times increase by 10X – Sourcing availability and DoD programs impacted
- 2008 – Services Sponsored Programs to Recover Refractory
 - April 2008, MetalOC-ALC Tinker AFB / GDIT start SMRRP Period of Performance
 - Jul 2008 – DA Sec Def directs NAVAIR to work w/ USAF, DLA (DNSC), DRMS, DSCR, and Gen. Arthur Morrell (No results noted - Navy explores independent “credit only” proof of concept with GEA.
 - Jun 2009 – Navy/GEA pilot “credit only” deal signed
 - May 2009 – SMRRP first “Notice of Availability “ to GE & Pratt for super-alloy auction
 - Jun 2010 – NAVAIR formal multi-year contract with GE
 - Jul 2010 – DLA-SM-MO outreach with AMARG regarding S&CM aviation scrap recovery results in contacts with Tinker AFB SMRRP representatives
 - Oct 2010 – DLASM delegation to ALC/processing facilities for process evaluation & meetings
 - Apr 2011 - USAF Economic Analysis reports SMRRP Proof of concept self funding & self sustaining with significant ROI
 - May 2011 - Air Force Audit Agency reports no adverse findings in SMRRP
- FY 2012 – DLA SM “DRAFT” Material Disposition Determination Documents for rhenium completed
 - Program under review regarding legal and work to be performed
 - Services and DLA SM coordination still on-going



Rare Earth Materials Program (Policy)

17 REEs, known as lights (cerium group – La, Ce Pr, Nd, Pm, Sm, Eu) and heavies (yttrium group – Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu), with “1000’s” of applications.





Rare Earth Materials Programs (Recommend Policy)

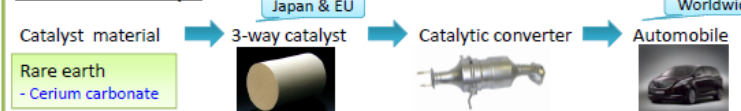
Examples of global supply chain

➤ The supply chain is integrated on a global scale.

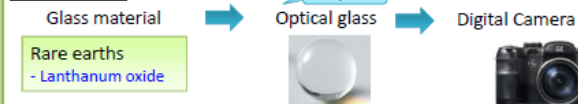
Personal Computer



Exhaust Gas Catalyst



Optical Glass



Examples of global supply chain

Permanent Magnet



Phosphor



Fluid Catalytic Cracking (FCC) Catalyst



- Base Ores, Processing and Final Products Involve World-Wide Trade Activities



DLA Strategic Materials, Actions to Effect Policy

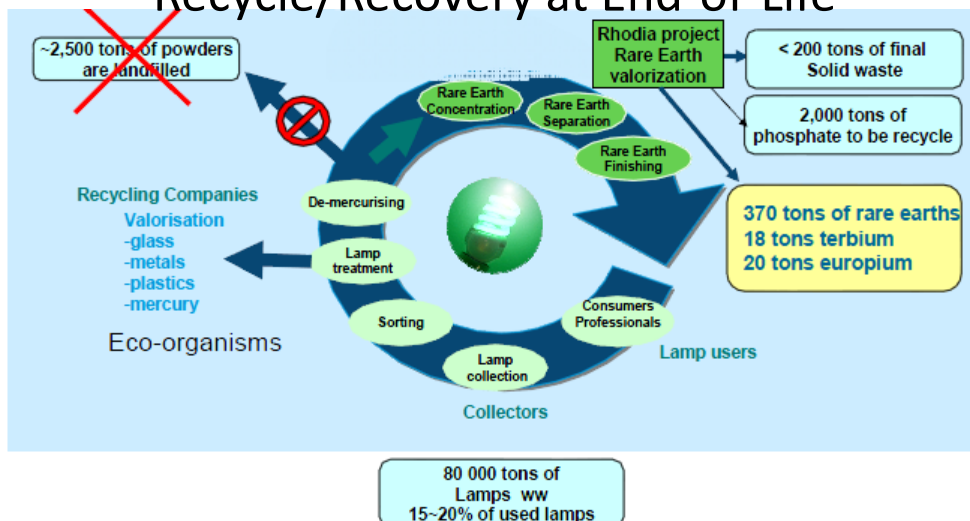
- **2011 NDAA, section 843**, report to congress on criticality of REE to DoD and Essential Civilian, finalized Jan 2012
- **2011 DLA SM RR Update** to congress, established REE strategic need for DoD and Essential Civilian.
- **2012 NDAA, section 853**, report to congress on establishment of NDS REE inventory, in work and expected to congress Sep 2012.
- **2012 NDAA, Section 1080**, HRC 112-329, report to Congress on REE Recycle Desirability and Feasibility is “in-work”.
- **2013 DLA SM RR** report to congress, material list focuses on REE strategic and DoD critical needs, in work with suspense of Jan., 2013.
- **Participant and member** in series of private industry/academic, inter-agency and international working groups;
 - Yale University (Materials Criticality Working Group)
 - “843/853” Working Groups (inter-service)
 - DOE (AMO, HUB, tri-lateral US, EU, JP)
 - TTCP (international GB, CA, AU, NZ), METI/JOGMEC (international US, JP)



Examples of Existing Governmental Policy and Incentive Programs

EU Program for Phosphors

Recycle/Recovery at End-of-Life



Japan Program for Abrasives Recycling

A example of policy package in Japan

Cerium oxide
for abrasives



6/2011 Inport-157ton

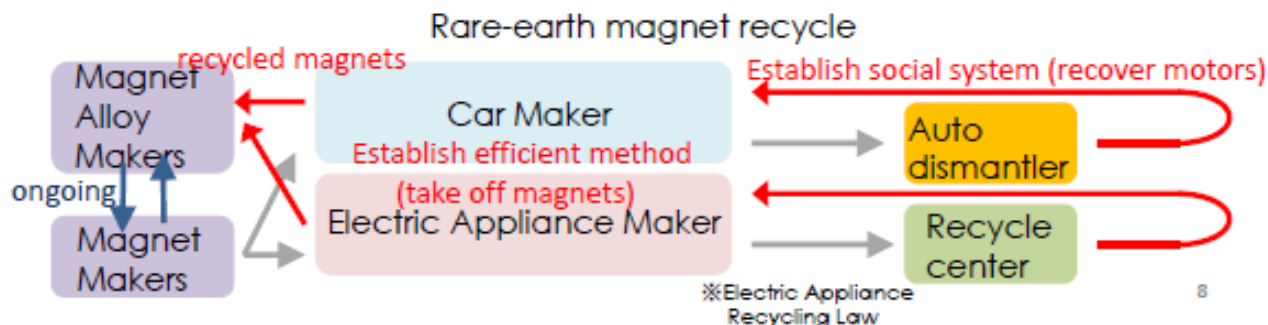
1. Promoting repeated use by improvement of abrasive process

2. Promoting recycling by improvement of abrasive machine

3. Promoting the development of substitute materials
(Substitute materials ZrO_2 , Mn_2O_3)

Japan's domestic demand for cerium is expected to decrease by half.

Proposed EU Program Promoting Magnet Recycling





Titanium Plate Purchase Program (Front-End Material Conservation, Recycle)

- Joint program between DoD and ARDEC to take advantage of established contracts at DLA Strategic Materials
- Using IDIQ contract, using set price and set customer and order
- Processing of purchased plates using water-jet cutting technology to minimize scrape and mill tailings.



- Net-shape parts are directly cut from rolled plates.
- Resulting “OFFAL” is easily recycled and not a contaminated waste
- Vendor committed to buy-back all cut-stock
- Program resulted in over \$1.5MM in material related savings





Future possible programs

- Fluorspars (reclaim of industrial by-products)
- Ir upgrade - reclaim
- Sn upgrade (recovery of oxidized materials)
- III-V Metals (CZT wafering and Te program excess)
- Alternative Energetics
- Recovery of all DOE and other service/agency DOD program related excess materials (Be, BeO, Te, etc.)



QUESTIONS?

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DEFENSE LOGISTICS AGENCY

AMERICA'S COMBAT SUPPORT LOGISTICS AGENCY

