U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
Subcommittee on Energy and Environment

HEARING CHARTER

Energy Critical Elements: Identifying Research Needs and Strategic Priorities

Wednesday, December 7, 2011
10:00 a.m. to 12:00 p.m.
2318 Rayburn House Office Building

Purpose

On Wednesday, December 7, 2011, at 10:00 a.m. in Room 2318 of the Rayburn House Office Building, the Subcommittee on Energy and Environment will hold a hearing titled *"Energy Critical Elements: Identifying Research Needs and Strategic Priorities*." The purpose of this hearing is to receive testimony on research needs and priorities relating to Energy Critical Elements (ECE) and examine H.R. 2090, "The Energy Critical Elements Advancement Act of 2011."

Witnesses

- **The Honorable David Sandalow**, Assistant Secretary for Policy and International Affairs, Department of Energy
- **Dr. Derek Scissors,** Research Fellow, Heritage Foundation
- **Dr. Robert Jaffe,** Jane and Otto Morningstar Professor of Physics, Massachusetts Institute of Technology
- **Dr. Karl Gschneidner,** Senior Materials Scientist, Ames National Laboratory
- **Mr. Luka Erceg,** President and CEO, Simbol Materials

Background

Energy Critical Elements

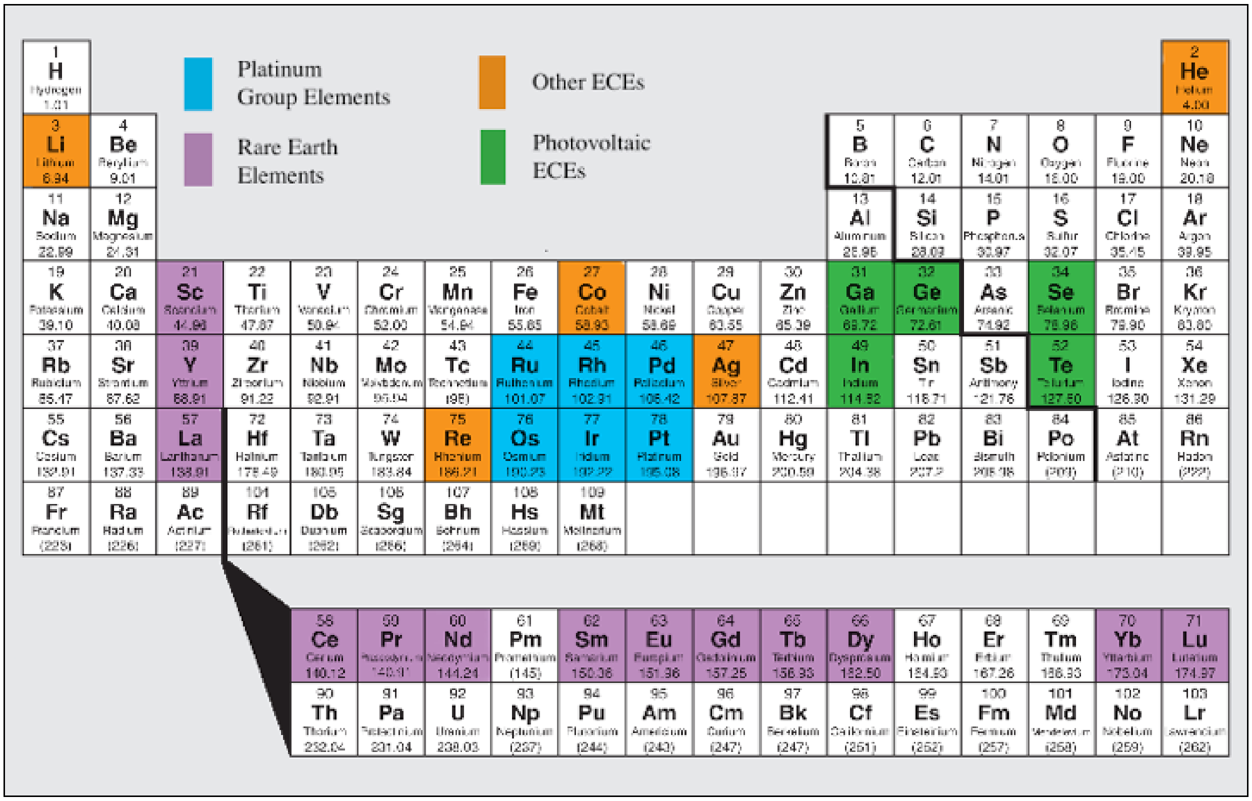
A recent report published by the American Physical Society (APS) and Materials Research Society (MRS) defines Energy Critical Elements as a "class of chemical elements that currently appear critical to one or more new, energy-related technologies. A shortage of these elements would significantly inhibit large-scale deployment, which could otherwise be capable of transforming the way we produce, transmit, store, or conserve energy."[1]

[1] American Physical Society & Materials Research Society, *"Energy Critical Elements: Securing Materials for Emerging Technologies*," February 2011. Accessible at: http://www.aps.org/policy/reports/popa-reports/upload/elementsreport.pdf

ECEs are generally not widely extracted, nor is there a mature, commoditized ECE market. The APS-MRS study also notes ECEs may not be domestically available and "many potential ECEs are not found in concentrations high enough to warrant extraction as a primary product."[2]

As indicated by their name, ECEs are key components in many energy technologies. For example, neodymium is used for high-field permanent magnets required in wind turbines and hybrid cars. Tellurium is necessary for a new photovoltaic solar cell technology. Included as potential ECEs, the APS/MRS report identifies the platinum group of elements, located in the center of the periodic table, as well as elements frequently used in photovoltaic solar cells such as gallium (Ga), germanium (Ge), selenium (Se), indium (In), and tellurium (Te).

Figure 1 – Energy Critical Elements[3]



Rare Earths

Of particular interest and importance within ECEs is a family of elements known as rare earth elements (REE). Rare earth elements consist of yttrium, scandium, and the 15 elements contained within the Lanthanide series on the periodic table of elements with atomic numbers ascending from 57 to 71.

[2] APS/MRS Report, p. 5
[3] Ibid.

Despite their moniker, REEs are not rare, but rather abundant in the Earth's crust. However, the concentrations of REEs are generally low, limiting the opportunity to economically mine and separate elements for processing and use. Some REEs are obtained as byproducts of mining more abundant ore, such as copper, gold, uranium, phosphates, and iron. [4]

REEs are generally classified as either light rare earth elements (LREE) or heavy rare earth elements (HREE). LREEs, elements with atomic numbers 57 to 63, are more abundant, more widely used, and easier to separate with mining techniques. HREEs, elements with atomic number 64 through 71, are generally less available and more difficult to extract. HREE's ability to withstand higher temperatures than LCEEs makes them more suitable for specific energy applications and the United States Geological Survey (USGS) describes HREEs as "particularly desirable."[5]

Figure 2 – Rare Earth Elements: Selected End Uses[6]

Light Rare Earths (more abundant)	Major End Use	Heavy Rare Earth (less abundant)	Major End Use
Lanthanum	hybrid engines, metal alloys	Terbium	phosphors, permanent magnets
Cerium	auto catalyst, petroleum refining, metal alloys	Dysprosium	permanent magnets, hybrid engines
Praseodymium	magnets	Erbium	phosphors
Neodymium	auto catalyst, petroleum refining, hard drives in laptops, headphones, hybrid engines	Yttrium	red color, fluorescent lamps, ceramics, metal alloy agent
Samarium	magnets	Holmium	glass coloring, lasers
Europium	red color for television and computer screens	Thulium	medical x-ray units
		Lutetium	catalysts in petroleum refining
		Ytterbium	lasers, steel alloys
		Gadolinium	magnets

[4] Congressional Research Service, *"Rare Earth Elements: The Global Supply Chain,"* September 6, 2011. p. 8
[5] Department of Interior, United States Geological Survey Fact Sheet 087-02, "Rare Earth Elements – Critical Resources for High Technology," 2002. Accessible at: http://pubs.usgs.gov/fs/2002/fs087-02/
[6] CRS Report, p. 3

The unique physical and chemical characteristics of REEs make them attractive for use in a number of key specialty applications. For example, alloys of numerous rare earth elements are key components of strong, permanent magnets desired in a wide range of hi-tech applications. End-use applications range from automobile catalysts to cell phones and televisions to medical devices. REEs are also of great importance for defense applications, such as jet engines and satellite systems.

Beyond rare earths, several other ECEs are also important to energy technologies. Examples include: lithium and lanthanum for use in high performance batteries; helium for cryogenics, advanced nuclear reactor designs, and energy sector manufacturing; platinum group elements for fuel cell catalysts; and rhenium for use in an alloy for advanced turbines.[7]

Production and Supply Chain

The rare earth production and supply chain involves numerous phases, each with its own complex market dynamics. This begins with mining ore, followed by separating the rare earth oxides, refining the material, turning the oxides into a metal alloy, incorporating alloys into components and manufacturing end-use products. As a result of the complexity, the location of REE geologic deposits and mining facilities is a major factor in determining where manufacturers produce goods. For example, neodymium, gadolinium, dysprosium, and terbium are all key components in permanent magnets. Current mining and production of those elements is almost exclusively located in China. As a result about 75% of all current permanent magnet production also located there.[8]

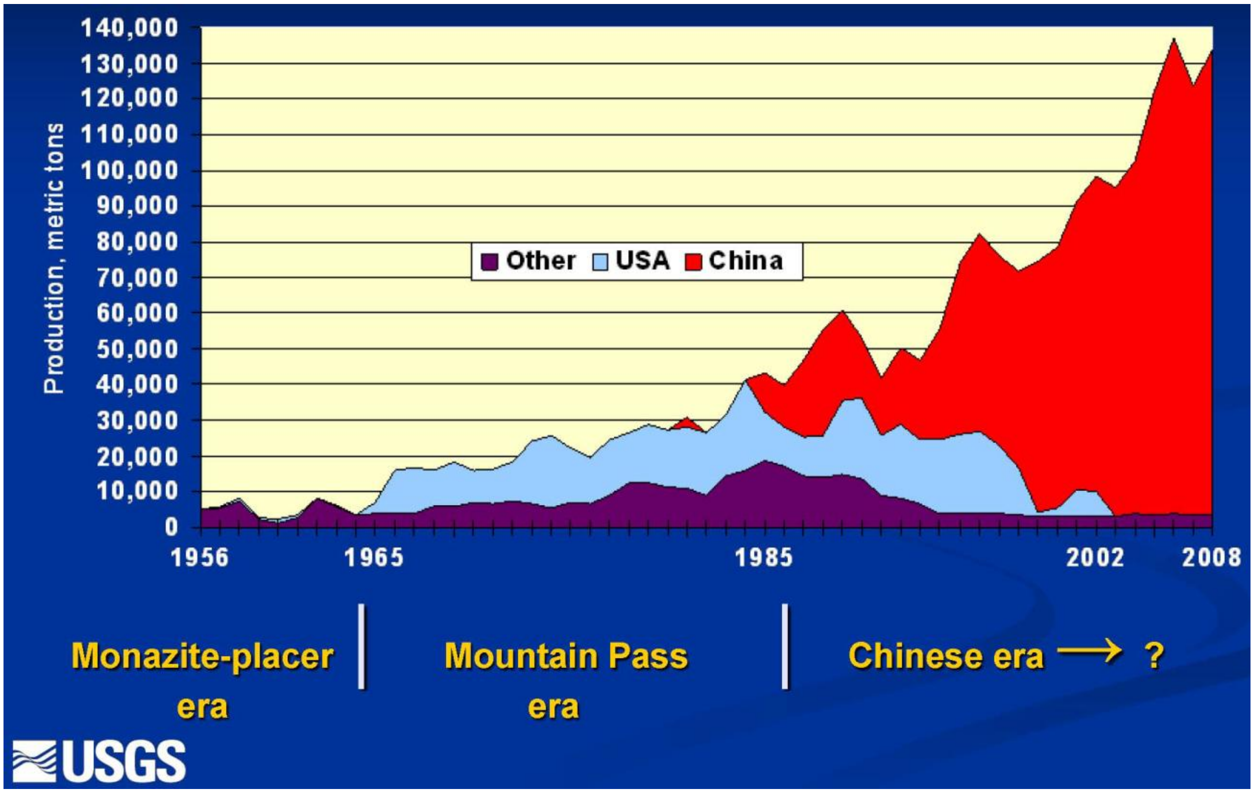
Market Conditions Impacting Energy Critical Elements

The United States was a dominant global producer of rare earth elements from the 1960's through the 1980's; however, downward price pressure from China and more restrictive environmental regulations in the United States drove REE production out of the United States and almost exclusively to China.

Prior to establishing market dominance, China developed a long range strategic action to exploit its rare earth natural resources. In 1992, Deng Xiaoping, a key figure leading China's economic reforms signaled this strategic direction, saying "there is oil in the Middle East; there is rare earth in China."[9] As China produced an increasing percentage of global REEs, the country began implementing policies to strengthen its market position.

[7] APS/MRS Report, p. 6
[8] CRS report. P. 2
[9] Peter Foster, "Rare earths: Why China is cutting exports crucial to Western technologies," The Telegraph, March, 19, 2011. Accessible at: http://www.telegraph.co.uk/science/8385189/Rare-earths-why-China-is-cutting-exports-crucial-to-Western-technologies.html

Figure 3 – Global rare-earth-oxide production trends[10]



Today, REEs are almost exclusively produced in China. The USGS estimates China produced 130,000 metric tons (mt) of rare earth ores, oxides, and metals in 2010, or 97% of global REE production.[11] While China currently produces almost all of the global REE supply, other countries have notable REE reserves yet to be extracted, including the United States, Australia, Brazil, India, Russia, South Africa, Malaysia, and Malawi.[12] As REE prices have risen, companies in numerous countries have announced plans to re-start and expand production.

However, China's stranglehold on current REE production has allowed it to disproportionately impact market prices and exploit their resource abundance through geopolitical means. Following a 2009 dispute with Japan on an unrelated matter, China suspended REE exports to its neighbor. Japan's high-tech economy is highly dependent on the availability of REEs and the country was forced to relent to China, resolve the incident, and resume REE imports.[13]

Soon thereafter, China reduced its export quota by 37 percent in 2010 from the prior year, ostensibly to limit the environmental impacts of mining REEs. Reducing the export quota placed

[10] Pui-Kwan Tse, "China's Rare-Earth Industry," USGS Report 2011-1042, 2011. Accessible at: http://pubs.usgs.gov/of/2011/1042/of2011-1042.pdf

[11] USGS Mineral Commodities Summaries 2010. Accessible at: http://minerals.usgs.gov/minerals/pubs/mcs/2011/mcs2011.pdf

[12] CRS Report p. 9

[13] Yuko Inoue, *"China lifts rare earth export ban to Japan,"* Reuters, September 29, 2010. Accessible at: http://www.reuters.com/article/2010/09/29/us-japan-china-export-idUSTRE68S0BT20100929

further supply constraints on a market in which global demand already exceeds supply. Additionally, China levies a 15 to 25 percent tax on REE exports.[14] These policies drove up the price of products manufactured outside of China and exert great pressure on companies to locate manufacturing facilities in China for a price advantage. For example, Intematix, a California-based producer of phosphor materials and LED lighting, moved manufacturing to China to directly purchase rare earth materials, rather than pay higher prices for exports. Intematix Director of Worldwide Operations said, "We saw the writing on the wall – we simply bought the equipment and ramped up in China to begin with….I think this is what the Chinese government wanted to happen."[15]

Market Reaction

China's policies led to significant price increases in REEs in the global market. The average September 2011 price for Chinese REE exports was 752 percent higher than the previous year.[16] However, as prices increased, the global market began to react. A number of companies announced their intention to open new production facilities and REE prices fell approximately 40 percent from the peak in July.[17]

In reaction to falling REE prices, China has again sought to take advantage of its market position to manipulate supply and maintain artificially high prices. In October, the Chinese state-owned company Inner Mongolia Baotou Steel Rare Earth Hi-Tech Company declared it would suspend production of REEs for one month "in an effort to prop up prices." [18]

In 2010, REE demand was estimated to be 136,000 mt while global production stood

[14] USGS 2011-1042 p. 8

[15] UPI, "Production shifts to China for rare earths," August 25, 2011. Accessible at: http://www.upi.com/Business_News/Energy-Resources/2011/08/25/Production-shifts-to-China-for-rare-earths/UPI-87711314293290/

[16] Ken Monahan, *"China's Monopoly on Rare-Earth materials: Implications for U.S. Companies,"* Bloomberg Government, November 16, 2011.

[17] Derek Scissors, *"Rare Earth Market Fine Without Government Interference,"* Heritage Foundation, November 2, 2011. Accessible at: http://www.heritage.org/research/reports/2011/11/rare-earth-market-fine-without-government-interference

[18] Leslie Hook, *"Largest rare earths producer halts output,"* Financial Times, Oct 16, 2011. Accessible at: http://www.ft.com/cms/s/0/eb817dd6-f976-11e0-bf8f-00144feab49a.html#axzz1fJYwvVtb

at 133,600 mt.[19] U.S.-based Molycorp began separation and processing of previously mined rare earth oxides at their Mountain Pass, CA facility to meet the production shortfall. Further, Molycorp announced its intentions to fully resume mining at Mountain Pass to produce 19,000 mt of rare earth oxide by the end of 2012.[20]

Demand for REEs is anticipated to continue increasing in the near future. For example, the secretary general of the Chinese Rare Earths Industry Association predicted REE demand will increase to 210,000 mt by 2015.[21]

The market's ability to quickly respond to supply shortfalls is limited by multiple factors. It is estimated up to 15 years of lead time is required to open a new mine,[22] which hinders the market's ability to quickly respond to price fluctuations and increased demand. Also, to open a new production facility up to $1 billion in capital is necessary, which may be difficult to acquire in the current financial markets.

<u>Key Issues</u>

Future Supply Chain Issues

Opportunities exist within each portion of the supply chain to impact the availability and price of REE. In addition to Molycorp's Mountain Pass project, Lynas Corporation is expanding production at its Mt. Weld facility in Australia to produce over 20,000 mt of rare earth oxides. The Department of Energy (DOE) also notes additional mines in Australia, Brazil, Canada and Vietnam may begin production in the next five years.[23]

Intellectual Property Challenges and Substitute Development

Gaining access to raw material is only one challenge in securing ECE products. Industry must be able to manufacture raw materials into commercial products. Currently, no U.S. company produces neodymium high-grade permanent magnets, commonly used in consumer electronics, wind turbines, and defense applications. Hitachi, a Japanese company, owns the key patent for the production of the world's most powerful magnets and has chosen to greatly restrict its licensing. Without a license from Hitachi or invention of a new production method, permanent magnet production is likely to remain overseas regardless of domestic mining and processing activities.

In light of restricted availability to key ECEs, some companies are exploring substitute materials. Toyota and General Electric recently announced their intentions to scale back ECE use in cars and wind turbines.[24] Jack Lifton, an investor analyst, noted, "the principal customer for rare-earth

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[19] USGS Mineral Commodity Summaries, January 2011.
[20] Molycorp, Project Phoenix. Accessible at: http://www.molycorp.com/AboutUs/ProjectPhoenix.aspx
[21] "Global Rare Earth Demand to Rise to 210,000 Metric Tons by 2015," Bloomberg News, October 18, 2010.
[22] Government Accountability Office, "*Rare Earth materials in the Defense Supply Chain*," April 14, 2010. Accessible at: http://www.gao.gov/new.items/d10617r.pdf
[23] U.S. Department of Energy "*Critical Materials Strategy,*" December 2010. Accessible at: http://energy.gov/sites/prod/files/edg/news/documents/criticalmaterialsstrategy.pdf
[24] Sonja Elmquist, "Rare Earths Fall as Toyota Develops Alternatives," Bloomberg News, September 28, 2011. Accessible at: http://www.bloomberg.com/news/2011-09-28/rare-earths-fall-as-toyota-develops-alternatives-commodities.html

metals is a global automotive industry using rare-earth permanent magnets. That industry will engineer this stuff out."[25]

Federal Activities

A number of Executive Branch agencies are actively addressing ECE challenges. Since March 2010, the White House Office of Science and Technology Policy (OSTP) has coordinated an Interagency Working Group on Critical and Strategic Mineral Supply Chains. OSTP created a new Subcommittee on Critical and Strategic Mineral Supply Chains, with the purpose to "advise and assist [OSTP] on policies, procedures and plans relating to risk mitigation in the procurement and downstream processing of critical and strategic minerals. Functions of the Subcommittee include identifying critical and strategic minerals and identifying cross-agency research and development opportunities."[26]

Participants in the working group include the DOE, Department of Defense (DOD), USGS, Department of Commerce, Environmental Protection Agency, Department of Justice, Department of State, and the U.S. Trade Representative.

DOE Critical Materials Strategy

In December 2010, the Department of Energy released its *"Critical Materials Strategy*" to examine the "role of rare earth metals and other materials in the clean energy economy" and focus on the "role of key materials in renewable energy and energy-efficient technologies."[27] DOE describes plans to "(i)develop its first integrated research agenda addressing critical materials…(ii)strengthen its capacity for information-gathering on this topic; and (iii) work closely with international partners, including Japan and Europe, to reduce vulnerability to supply disruptions and address critical material needs."[28]

DOE's strategy is supported by three key points. Namely:

1. A"diversified global supply chain [is] essential." Supply risk must be mitigated by sourcing of critical materials from multiple sources. To achieve this, steps must be taken to "facilitate extraction, processing and manufacturing here in the United States, as well as encourages other nations to expedite alternative supplies;"
2. "[S]ubstitutes must be developed." Research and development of materials of equal material and technology veracity will allow the clean energy economy to satisfy their material needs, and;
3. "[R]ecycling, reuse and more efficient use could significantly lower world demand for newly extracted materials."

DOE's strategy only focused on the needs for REEs in the context of the energy sector. It did not consider the importance of REEs for other sectors, including defense, nor did it address material concerns beyond REEs. DOE will release an update to the report prior to the end of 2011.

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[25] Ibid.
[26] Critical Materials Strategy, p. 58.
[27] Critical Materials Strategy p. 10
[28] Critical Materials Strategy, p. 6

DOE Research and Development Activity

DOE funds ECE-related research through numerous programs. Within the Office of Science, the Basic Energy Sciences' Materials Sciences and Engineering Division provided $5 million in Fiscal Year (FY) 2010 for materials research at Ames National Laboratory.

The Advanced Research Projects Agency – Energy (ARPA-E) funds high-risk, high-reward, transformational energy research. ARPA-E has funded 11 targeted research areas to date, including the Batteries for Electric Energy Storage in Transportation (BEEST) to develop new battery technologies that are less reliant on ECEs. ARPA-E also provided $2.2 million to General Electric Global Research to develop "next-generation permanent magnets with a lower content of critical rare earth materials" The new magnets would be more efficient and increase power density, while reducing the quantity of ECEs.[29]

Within the Office of Energy Efficiency and Renewable Energy (EERE), the Vehicle Technologies Program, Industrial Technologies Program, and the Wind Technologies Program fund ECE-related research. The research includes exploring new battery technologies, researching next generation materials research, and producing higher efficiency permanent magnets for increased performance in wind turbines.[30]

Critical Materials Energy Innovation Hub

The Administration's budget request proposed creating a new Energy Innovation Hub on Critical Materials to be overseen by EERE's Industrial Technologies Program. According to DOE:

> "The hub will fund R&D on novel approaches to reducing our dependencies on critical materials. The hub will focus on R&D leading to material and technology substitutes that will improve flexibility and help meet the material needs of the clean energy economy. Additional R&D goals include strategies for recycling, reuse, and more efficient use that could significantly lower world demand for newly extracted materials."[31]

The House-passed Energy & Water Appropriations bill included $20 million in FY 2012 for the Critical Materials Hub.

Department of Defense

In September 2011, DOD delivered its *Annual Industrial Capabilities Report* to Congress[32]. The report assessed the importance of rare earth materials to national security and concluded that:

[29] Advanced Research Projects Agency – Energy, "GE Global Research: Transformational Nanostructured Permanent Magnets." Accessible at: http://arpa-e.energy.gov/ProgramsProjects/OtherProjects/VehicleTechnologies/TransformationalNanostructuredPermanentMagnets.aspx

[30] For more information on current DOE critical materials R&D, see Chapter 4 of the Critical Materials Strategy.

[31] Department of Energy, "FY 2012 Congressional Budget Request: Volume 3,." p. 257. Accessible at: http://www.cfo.doe.gov/budget/12budget/Content/Volume3.pdf

[32] Office of Manufacturing & Industrial Base Policy, "Annual industrial Capabilities Report to Congress," Department of Defense, September 2011. Accessible at: http://www.acq.osd.mil/mibp/docs/annual_ind_cap_rpt_to_congress-2011.pdf

> "The Department relies on RE materials in the production of many of its weapon systems and needs to ensure their continued availability to meet national security objectives and military superiority…It is essential that a stable non-Chinese source of REO be established so that the U.S. RE supply chain is no longer solely dependent on China's RE exports. It is also essential to develop non- Chinese RE sources that in total create an RE supply that meets the U.S. demand for both heavy and light rare earth elements (REEs)"

The report also recommended that DOD:

- "develop and implement risk mitigation strategies for the heavier elements, especially dysprosium, yttrium, praseodymium, and neodymium.";
- "identify and priorities [rare earth] product applications in order to mitigate/diminish supply and scheduling disruptions to selected DOD systems.";
- "partner with the domestic [rare earth] companies to determine what assistance may be needed to retain or obtain [rare earth] processing capabilities."; and
- "continue monitoring the health of the domestic [rare earth] companies in the supply chain."

Congressional Proposals

In the 112th Congress, ten bills have been introduced to address various ECE and REE issues (Appendix A). Additionally, multiple Congressional Committees, including the Science, Space, and Technology Subcommittee on Investigations and Oversight,[33] held hearings to consider ECE oversight issues and legislative proposals.

To date, one rare earth proposal has seen legislative action. On July 20, 2011, the House Natural Resources Committee passed H.R. 2011, the "National Strategic and Critical Minerals Policy Act of 2011," sponsored by Rep. Lamborn. H.R. 2011 currently awaits consideration by the full House.

H.R. 2090, the "Energy Critical Elements Advancement Act of 2011" was introduced by Representative Randy Hultgren on June 2 (Appendix B). The legislation directs the Department of Interior and DOE to improve resource assessments through direct coordination. The bill also designates USGS as the Principal Statistical Agency to gather ECE resource information. H.R. 2090 authorizes a DOE research program to "establish advance basic knowledge and enable expanded availability of designated energy critical elements; and develop and update biennially an integrated research plan to guide program activities."[34] Lastly, the bill requires OSTP to produce a report for Congress on recycling of energy critical elements.

[33] Committee on Science, Space, and Technology, Investigations and Oversight Subcommittee hearing "Critical Materials Strategy," June 14, 2011. More information can be found at: http://science.house.gov/hearing/investigations-and-oversight-subcommittee-hearing-critical-materials-strategy

[34] Congressional Research Service Bill Summary.

Appendix A

Rare Earth-Related Legislation in the 112th Congress[35]

H.R. 1388, the Rare Earths Supply Chain Technology and Resources Transformation Act of 2011

> Introduced by Representative Mike Coffman on May 6, 2011, and referred to the House Committee on Science, Space, and Technology, Subcommittee on Energy and the Environment, and the Committees of Natural Resources and Armed Services. The bill is also referred to as the Restart Act of 2011. The bill seeks to reestablish a competitive domestic rare earths supply chain within DOD's Defense Logistics Agency (DLA).

H.R. 1540, the National Defense Authorization Act for FY2012

> Introduced by Representative Howard McKeon on April 14, 2011. Section 835 would require the Defense Logistics Agency Administrator for Strategic Materials to develop an inventory for rare earths materials to support defense requirements, as identified by the report required by Section 843 of the National Defense Authorization Act for FY2011 (P.L. 111-383).

H.R. 1314, the Resource Assessment of Rare Earths (RARE) Act of 2011

> Introduced by Representative Hank Johnson on April 1, 2011; referred on April 6 to the House Natural Resources Committee's Subcommittee on Energy and Mineral Resources. The bill would direct the Director of the U.S. Geological Survey through the Secretary of the Interior to examine the need for future geological research on rare earth elements and other minerals and determine the criticality and impact of a potential supply restriction or vulnerability.

H.R. 952, the Energy Critical Elements Renewal Act of 2011

> Introduced by Representative Brad Miller on March 8, 2011; referred to the Committee on Science, Space, and Technology. The bill would develop an energy critical elements program, amend the National Materials and Minerals Policy Research and Development Act of 1980, establish a temporary program for rare earth material revitalization, and serve other purposes.

S. 383, the Critical Minerals and Materials Promotion Act of 2011

> Introduced by Senator Mark Udall on February 17, 2011; referred to the Committee on Energy and Natural Resources. The bill would require the Secretary of the Interior to establish a scientific research and analysis program to assess current and future critical mineral and materials supply chains, strengthen the domestic critical

[35] Appendix A compiled by Congressional Research Service. Appendix in CRS Report R41347.

minerals and materials supply chain for clean energy technologies, strengthen education and training in mineral and material science and engineering for critical minerals and materials production, and establish a domestic policy to promote an adequate and stable supply of critical minerals and materials necessary to maintain national security, economic well-being, and industrial production with appropriate attention to a long-term balance between resource production, energy use, a healthy environment, natural resources conservation, and social needs.

H.R. 618, the Rare Earths and Critical Materials Revitalization Act of 2011

Introduced by Representative Leonard Boswell on February 10, 2011; referred to the Committee on Science, Space, and Technology. The bill seeks to develop a rare earth materials program and amend the National Materials and Minerals Policy, Research and Development Act of 1980. If enacted, it would provide for loan guarantees to revitalize domestic production of rare earths in the United States.

S. 1113, the Critical Minerals Policy Act of 2011

Introduced by Senator Lisa Murkowski on May 26, 2011; referred to the Committee on Energy and Natural Resources. The bill would define what critical minerals are, but would request that the Secretary of the Interior establish a methodology (in consultation with the National Academy of Sciences, the National Academy of Engineering and various Department Secretaries) that would identify which minerals qualify as critical. The Secretary of the Interior would direct a comprehensive resource assessment of critical mineral potential in the United States, including details on the critical mineral potential on federal lands. S. 1113 would establish a Critical Minerals Working Group to examine the permitting process for mineral development in the United States and facilitate a more efficient process; specifically, that would require a performance metric for permitting mineral development and report on the timeline of each phase of the process. The Department of the Interior (DOI) would produce an Annual Critical Minerals Outlook report that would provide forecasts of domestic supply, demand, and price for up to ten years. The proposed Annual Critical Minerals Outlook would also assess critical mineral requirements for national security, energy, and economic well-being, and provide analyses of the implications of potential supply shortfalls. It would provide projections for recycling and market penetration of alternatives and international trends associated with critical minerals. Section 109 proposes greater international cooperation with allies on critical minerals and supply chain issues. If it was determined that there is no viable production capacity in the United States, a series of activities may occur with allies, led by the Secretary of State and Secretary of the Interior.

DOE would lead research and development on critical minerals and workforce development that would support a fully integrated supply chain in the United States. Title II of the bill recommends mineral-specific action (led by DOE) for cobalt, helium, lead, lithium, low-btu gas, phosphate, potash rare earth elements, and thorium. For example, there would be R&D for the novel use of cobalt, grants for domestic lithium production R&D, and a study on issues associated with establishing a licensing pathway for the complete thorium nuclear fuel cycle. Title III would repeal 1980 Minerals Policy Act and Critical Minerals Act of 1984 and would authorize for appropriation, $106 million.

H.R. 2011, the National Strategic and Critical Minerals Policy Act of 2011

Introduced by Representative Doug Lamborn on May 26, 2011; referred to the Committee on Natural Resources. The bill would direct the Secretary of the Interior to prepare a report on public lands that have been withdrawn or are otherwise unavailable for mineral exploration and development, mineral requirements of the United States, the nation's import reliance on those minerals, a timeline for permitting mineral-related activities on public lands, and the impacts of litigation on issuing mineral permits, among other things. The bill provides an authorization for appropriation, to the Secretary of the Interior, of $1 million for fiscal years 2012 and 2013. The House Committee on Natural Resources marked up and reported out H.R. 2011 on July 20, 2011.

H.R. 2090, the Energy Critical Elements Advancement Act of 2011

Introduced by Representative Randy Hultgreen on June 2, 2011. The bill would require collaboration between the Secretary of the Interior and Secretary of Energy to improve assessments of "energy critical elements throughout the supply chain, supply, demand, disposal and recycling." Additionally it calls for more R&D on materials use substitution, recycling, and life-cycle analysis. The bill provides a list of energy critical elements.

H.R. 2184, the Rare Earth Policy Task Force and Materials Act

Introduced by Representative Mike Coffman on June 15, 2011. The bill would create a Rare Earth Task Force within the DOI and be composed of the Secretary or designees from DOE, DOC, DOS, DOD, USDA, OMB, and CEQ, chaired by the Secretary of the Interior. The task force would examine impediments to domestic development of a REE supply chain. The Secretary of the Interior would prepare a Materials Program Plan of R&D that would support and help ensure long-term viability of a domestic rare earth industry. The plan would support numerous activities related to improved assessment and development technology, processing technology, and end-use applications. The bill would encourage expanding opportunities for higher education in that it would support the build-out of the rare earth supply chain

Appendix B

H.R.2090

Energy Critical Elements Advancement Act of 2011

112th CONGRESS
1st Session
H. R. 2090

To improve assessments of and research about energy critical elements, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

June 2, 2011

Mr. HULTGREN (for himself, Mrs. BIGGERT, and Mr. LIPINSKI) introduced the following bill; which was referred to the Committee on Science, Space, and Technology, and in addition to the Committees on Natural Resources and Energy and Commerce, for a period to be subsequently determined by the Speaker, in each case for consideration of such provisions as fall within the jurisdiction of the committee concerned

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A BILL

To improve assessments of and research about energy critical elements, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Energy Critical Elements Advancement Act of 2011'.

SEC. 2. INFORMATION GATHERING, ANALYSIS, AND DISSEMINATION.

(a) Establishment- The Secretary of the Interior, acting through the Director of the USGS, and the Secretary of Energy, acting through the Administrator of the Energy Information Administration, shall collaborate to improve assessments of energy critical elements that includes--

(1) discovered and potential resources;
(2) production;
(3) use;
(4) trade;

(5) disposal; and
(6) recycling.

(b) Duties- The entity within the USGS that gathers the information for the assessments under subsection (a) shall--

(1) regularly survey emerging energy technologies and the supply chain for elements throughout the periodic table necessary for those technologies in order to forecast potential supply disruptions; and
(2) make available such information in the aggregate, with appropriate protection of proprietary information, to the United States scientific community, including industry, institutions of higher education, and the United States Department of Energy National Laboratories and Technology Centers.

(c) Designation- The Director of the USGS shall designate the entity within the USGS that gathers the information for the assessments under subsection (a) as a `Principal Statistical Agency'.

SEC. 3. RESEARCH.

(a) Establishment- The Secretary of Energy, in coordination with the Secretary of the Interior, shall establish a research program to advance basic knowledge and enable expanded availability of energy critical elements, including research on basic materials science, chemistry, physics, and engineering associated with energy critical elements, including materials characterization and substitution, recycling, and life-cycle analysis.

(b) Research Plan- In consultation with the Critical and Strategic Mineral Supply Chain Subcommittee of the National Science and Technology Council, the Secretary shall develop and update biennially an integrated research plan to guide program activities.

(c) Limitation- Research under subsection (a) shall be limited to areas that industry is not likely to undertake due to technical and financial uncertainty.

SEC. 4. REPORT.

Within 1 year after the date of enactment of this Act, the Critical and Strategic Mineral Supply Chain Subcommittee of the National Science and Technology Council shall submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a report on the recycling of energy critical elements, including--

(1) the logistics, economic viability, and research and development needs for completing the recycling process;

(2) options for both the Federal Government and industry, including an assessment of the strengths and weaknesses of such options, for improving the rates of

collection of post-consumer products containing energy critical elements; and

(3) an analysis of the methods explored and implemented in various states and countries, such as Japan and South Korea.

SEC. 5. DEFINITIONS.

In this Act, the following definitions apply:

(1) ENERGY CRITICAL ELEMENT- The term `energy critical element' means each of the following:

(A) Helium.
(B) Lithium.
(C) Scandium.
(D) Cobalt.
(E) Gallium.
(F) Germanium.
(G) Selenium.
(H) Yttrium.
(I) Ruthenium.
(J) Rhodium.
(K) Palladium.
(L) Silver.
(M) Indium.
(N) Tellurium.
(O) Lanthanum.
(P) Rhenium.
(Q) Osmium.
(R) Iridium.
(S) Platinum.
(T) Cerium.
(U) Praseodymium.
(V) Neodymium.
(W) Samarium.
(X) Europium.
(Y) Gadolinium.
(Z) Terbium.
(AA) Dysprosium.
(BB) Ytterbium.
(CC) Lutetium.
(DD) Any other element designated as an energy critical element by the Critical and Strategic Mineral Supply Chain Subcommittee of the National Science and Technology Council.

(2) USGS- The term `USGS' means the United States Geological Survey.