U.S. Department of Energy – Critical Materials Strategy
Request for Information (RFI)

DATE: March 22, 2011

SUBJECT: Request for Information (RFI)

DESCRIPTION: In December 2010, DOE issued its first *Critical Materials Strategy* (available at: http://www.energy.gov/news/documents/criticalmaterialsstrategy.pdf). The report found that several clean energy technologies—including wind turbines, electric vehicles, photovoltaic cells and fluorescent lighting—use materials at risk of supply disruptions in the short term. In the report, five rare earth metals (dysprosium, neodymium, terbium, europium and yttrium), as well as indium, were assessed as most critical in the short term. For this purpose, "criticality" is a measure that combines importance to the clean energy economy and risk of supply disruption.

This year, DOE will update its analysis in light of rapidly-changing market dynamics. DOE will analyze the use of critical materials in petroleum refineries and may examine the use of critical materials in other applications not addressed in last year's report. Finally, DOE may identify specific strategies for materials identified as critical, including strategies with respect to substitution, recycling and more efficient use.

PURPOSE: The purpose of this RFI is to solicit feedback from industry, academia, research laboratories, government agencies, and other stakeholders on issues related to demand, supply chain structure, financing, R&D, energy technology transitions and recycling of rare earth metals and other materials used in the energy sector. DOE is specifically interested in information on rare earth elements (e.g., yttrium, lanthanum, cerium, neodymium, terbium, europium, samarium, and dysprosium), gallium, lithium, cobalt, indium and tellurium, as well as other materials of interest identified by the respondents to this request. This is solely a request for information and not a Funding Opportunity Announcement (FOA). DOE is not accepting applications.

DISCLAIMER AND IMPORTANT NOTES: This is an RFI issued solely for information and program planning purposes; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. In accordance with the Federal Acquisition Regulations, 48 C.F.R. 15.201(e), responses to this notice are not offers and cannot be accepted by the Government to form a binding contract. DOE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that DOE is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind DOE to any further actions related to this topic.

PROPRIETARY INFORMATION: Patentable ideas, trade secrets, proprietary or confidential commercial or financial information, may be included in responses to this RFI. The use and disclosure of such data may be restricted, provided the respondent includes the following legend on the first page of the response narrative and specifies the pages of the response which are to be restricted:

"The data contained in pages _____ of this response have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for information and program planning purposes. This restriction does not limit the government's right to use or disclose data obtained without restriction from any source, including the respondent, consistent with applicable law."

To protect such data, each line or paragraph on the pages containing such data must be specifically identified and marked with a legend similar to the following:

"The following contains proprietary information that (name of respondent) requests not be released to persons outside the Government, except for purposes of review and evaluation."

EVALUATION AND ADMINISTRATION BY FEDERAL AND NON-FEDERAL PERSONNEL: Federal employees are subject to the non-disclosure requirements of a criminal statute, the Trade Secrets Act, 18 USC 1905. The Government may seek the advice of qualified non-Federal personnel. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The respondents, by submitting their response, consent to DOE providing their response to non-Federal parties. Non-Federal parties given access to responses must be subject to an appropriate obligation of confidentiality prior to being given the access. Submissions may be reviewed by support contractors and private consultants.

REQUEST FOR INFORMATION CATEGORIES:

<u>Category 1: Critical Material Content</u>

- What are the current and anticipated material requirements of the energy technology applications listed below? What level of purity is required? How much material loss occurs in manufacturing?
    - Lighting phosphors: terbium, europium, yttrium, lanthanum and cerium
    - Magnets in electric vehicle motors and wind turbine generators: neodymium, dysprosium and praseodymium
    - PV thin film cells: indium, gallium and tellurium
    - Batteries for electric vehicles or grid storage: lanthanum, lithium and cobalt
    - Fluid cracking catalysts: lanthanum and cerium
    - Catalytic convertors: cerium and lanthanum
    - New or anticipated catalytic applications: lanthanum and cerium
    - Gas turbine blades: coating and alloying elements

- Fuel cells: yttrium
- Nuclear control rods: indium, cobalt, rare earth metals
- Magnets in emerging applications, such as electric bicycles and refrigeration

Materials indicated are examples. Add others as required to identify current material usage. Provide information for current and anticipated future designs. Provide ranges where appropriate. Please express material requirements in terms of amounts of critical materials needed, percentage weight or other appropriate metric.

Category 2: Supply Chain and Market Projections

- For the technologies listed in Category 1, what are the process stages within the supply chain, and where geographically does each occur?
- How much rare earth inventory is maintained at different stages of the supply chain? In what form (oxide, metal, component, etc.)?
- What are the competitive advantages to producers in different locations with respect to material sources, labor and markets?
- How vertically integrated are the supply chains in different countries? Does this matter? Why?
- For permanent magnet motors, permanent magnet generators and permanent magnets, what is the projected global market demand and US market share over the next 15 years?
- For compact fluorescent lamps (CFLs), linear fluorescent lamps (LFLs), light-emitting diodes (LEDs) and lighting phosphors, what is the projected global market demand and US market share over the next 15 years?

Category 3: Financing and Purchase Transactions

- How much capital is required for a rare earth mine or processing plant? What capital sources are available?
- How are rare earth elements or other materials typically procured? Is there substantial use of long term contracting? What are typical terms and conditions for these contracts? What is the role of spot markets? What information about purchase transactions is publicly available ?
- Across the supply chain, how do you characterize material supply risk? How is material supply risk typically mitigated?

Category 4: Research, Education and Training

- What personnel needs do you anticipate related to rare earths in the next 10 years? From where do you currently hire professionals with expertise in rare earth elements?
- How many rare earth professionals are there in the United States and globally? What are their skills and backgrounds? What is the optimal number and distribution of expertise for the evolving market? How would you define “rare earth professional”?
- What is your R&D budget relating to the materials identified as critical in DOE’s *Critical Materials Strategy* (dysprosium, neodymium, terbium, europium, yttrium, indium)? What research (e.g.

material design, material processing, component design, substitutes) do you support? What complementary research would be valuable? What breakthroughs would be most beneficial?
- What courses or training programs are offered relating to critical materials?

Category 5: Energy Technology Transitions and Emerging Technologies

- How do you anticipate that technology transitions (e.g. fluorescent lights -> LED's, new battery technologies) will affect material availability over the next 15 years? What barriers, if any, inhibit transitions? What factors, if any, encourage transitions? Please share any insight or recommendations with respect to technology transitions.
- How do you expect the emergence of new energy or energy efficiency technologies (e.g. fuel cells, magnetic refrigeration) to affect material demand over the next 15 years?
- How do uncertainties regarding the future market for technologies and potential substitutes affect the business case for investment?

Category 6: Recycling Opportunities

- What quantities of critical materials (dysprosium, neodymium, terbium, europium, yttrium, indium) could potentially be recycled from industrial or post-consumer sources on what timeframe and at what cost?
- What recycling process innovations would increase recycling technical and economic viability?
- How could design for recyclability improve the level of recycling?
- What types of policies would optimize recycling?

Category 7: Mine and Processing Plant Permitting

- What are the mine and/or processing plant permitting steps in the US (on federal, state or private land) or other nations? How long does each step take?
- What wastes are typically generated during the production of rare earth elements? How are they currently managed? How can the waste streams be reduced or eliminated?
- For facilities that could produce rare earth elements or other materials as a co-product or by-product of another mining process, what additional permits are typically necessary?
- What are the main challenges in obtaining permits?
- Do transportation costs, distances or regulations play a significant role in commercial competitiveness of rare earth material production?

Category 8: Additional Information

- Do you use or expect increasing use of lithium, cobalt, gallium, yttrium, indium, tellurium, lanthanum, cerium, praseodymium, neodymium, samarium, europium, terbium or dysprosium for non-energy technologies? Please explain.
- Are there other materials that DOE should analyze (beyond lithium, cobalt, gallium, yttrium, indium, tellurium, lanthanum, cerium, praseodymium, neodymium, samarium, europium,

terbium and dysprosium) that may be of concern due to increasing demand for energy technologies and/or supply risk? Please explain.

- Is there additional information, not requested above, that you believe DOE should consider in updating the Critical Materials Strategy? If so, please provide here.

REQUEST FOR INFORMATION RESPONSE GUIDELINES: Responses to this RFI must be submitted electronically to materialstrategy@hq.doe.gov no later than 5:00pm (EDT) on May 24, 2011. Responses must be provided as attachments to an email. It is recommended that attachments with file sizes exceeding 25MB be compressed (i.e., zipped) to ensure message delivery. Only electronic responses will be accepted.

Please identify your answers by responding to a specific question or topic if possible. Respondents may answer as many or as few questions as they wish. Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development. DOE will review and consider all responses in its formulation of program strategies for the identified materials of interest that are the subject of this request.

DOE will not respond to individual submissions or publish publicly a compendium of responses. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed.

Respondents are requested to provide the following information at the start of their response to this RFI:

Company/Institution name; Company/Institution contact; Contact's address, phone number, and e-mail address.

DOE will not pay for information provided under this RFI. This RFI is not accepting applications for financial assistance or financial incentives. DOE has no obligation to respond to those who submit comments, and/or give any feedback on any decision made based on the responses received.