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# Rare Earth Elements- Applications and Recyclability

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A Summer Internship Experience  
at Sandia National Labs



# ABOUT ME

- Will be a senior at Valley High School this coming year
- Played tennis for 8 years and have been on the varsity tennis team at valley for what will be 4 years
- Interested in civil or environmental engineering at the Colorado School of Mines



# Pollution Prevention Group

- “The P2 program is a central element in Sandia National Laboratories' Environmental Management System. The P2 program applies to all activities that use resources and generate waste. P2 provides programmatic guidance and specifies strategies, activities, and methods to reduce the quantity and toxicity of waste and pollutants, conserve energy and resources, and purchase environmentally preferable products.”
  - Reduce, Reuse, Recycle; Sustainable acquisition, etc.
- Mentor: Samuel McCord- Solid Waste Recycling Planner
- By 2025, Zero Waste to the Landfill
- Won multiple awards for their work
  - **2011 EPA WasteWise Partner Recognition Award**
  - **3 DOE/NNSA Best in Class awards for 2011**



[rdsrecycle.com](http://rdsrecycle.com)

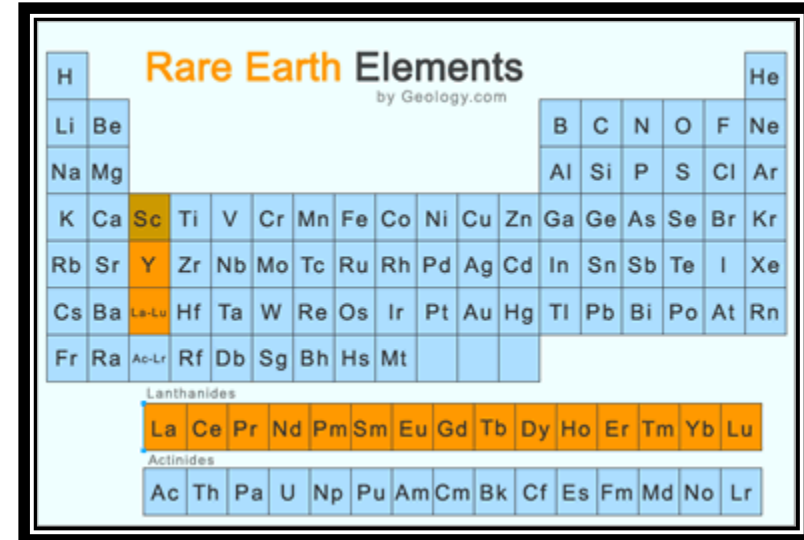


# Goals

- Personal
  - To experience a professional workplace environment
  - To develop a link between the classroom and a job
  - To better my understanding of the area where I am most interested in
  
- Research focus- Rare Earth Elements and their procurement, application and recycle
  
- Professional
  - To research Rare Earth Elements
  - To provide a clear and concise summary of the elements
  - To possibly create a new connection for Sandia Labs to use in the recycle of the elements

# Rare Earth Elements

- 17 Elements that have distinctive properties that enable them to do unique jobs
- Lanthanides + 2
  - Lanthanum, Cerium, Praseodymium, Neodymium, Promethium, Samarium, Europium, Gadolinium, Terbium, Dysprosium, Holmium, Erbium, Thulium, Ytterbium, Lutetium + Scandium and Yttrium
- Divided into two groups, Light Rare Earths and Heavy Rare Earths



The image shows a periodic table with the title "Rare Earth Elements" and "by Geology.com". The elements Scandium (Sc), Yttrium (Y), and the Lanthanide series (La through Lu) are highlighted in orange. The Lanthanide series is shown as a separate row below the main table, and the Actinide series (Ac through Lr) is shown as a separate row below that. The main table includes elements from Hydrogen (H) to Oganesson (Og).

Rare Earth Elements in the Periodic Table (Geology.com).

# Rare Earth Elements

## ■ Applications

- Energy- batteries, wind turbines, solar panels, additives to petroleum
- Electronics and Technology- cell phones and computers, TV displays, energy-efficient lighting, medicine
- Defense- lasers, missile guidance, stealth technology

## ■ Examples

- Neodymium is used in permanent magnets that are then used in computer hard drives and wind turbines
- Europium, Gadolinium and Terbium are used in combination as color phosphors for CRT color TVs
- Yttrium is used in a synthetic crystal called a garnet that is used for lasers to pass through
- Samarium is an active ingredient in a medicine called Quadramet (FDA) that is used as a painkiller for cancer patients

# Rare Earth Elements

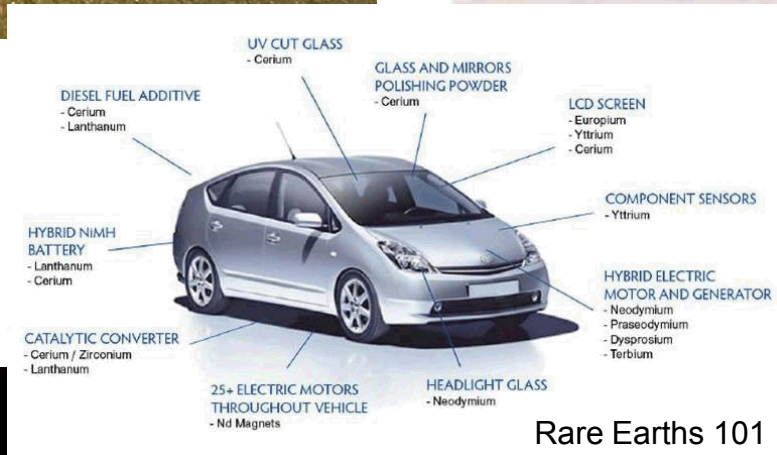
- As of right now, China produces 97% of the Rare Earths- 130,000 metric tons
- Early 2012- China decided to dramatically reduce production and exports
- Because of this, a company called Molycorp has decided to reopen its Mountain Pass mine in California to start producing rare earths after closing in 2002
- The mining and processing of rare earths is environmentally dangerous



australiangeographic.com.au



nytimes.com



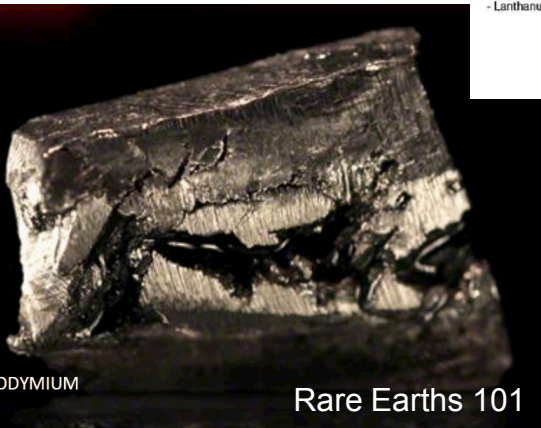
Rare Earths 101

U.S. DEPARTMENT OF ENERGY

# Critical Materials Strategy

December 2011

U.S. DEPARTMENT OF ENERGY



NEODYMIUM

Rare Earths 101

# Rare Earth Elements

- Can they be recycled?

**YES**

- Percent being recycled?

**<1%**

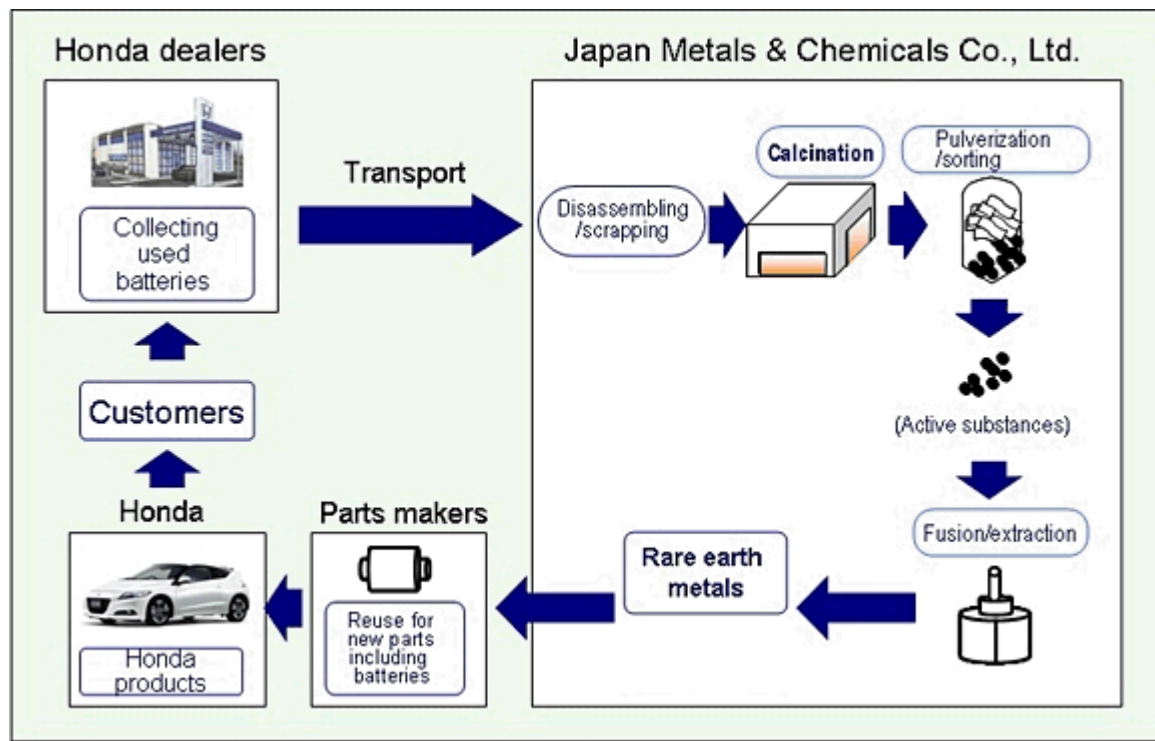


Honda.com

- Honda and Hitachi are the only companies who have initiated large-scale Rare Earth recycling plans

**HITACHI**  
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Hitachi.com



Honda Motor Co. Ltd.

Hitachi. Ltd.



Computer Hard Drives



Reclaimed REE magnets



Discarded compressors

# Rare Earth Elements

- What does that mean for Sandia?
  - Sandia National Labs uses 16 out of 17 Rare Earths
    - Promethium being left out
  - None of them are being recycled
  - SNL is currently holding a cubic yard box full of Neodymium hard drive magnets in storage.
  - Currently contacting DELL and Round2- an electronics recycler, Hitachi, Umicore- a European company who had developed a way to recycle batteries, and Lawrence Livermore National Laboratories, trying to find a pathway for rare earths.

# Other Experiences

- P2 Tent

- Within the first few days I had the opportunity to watch a shipment of ceiling tiles go out for recycle and reuse



BEFORE



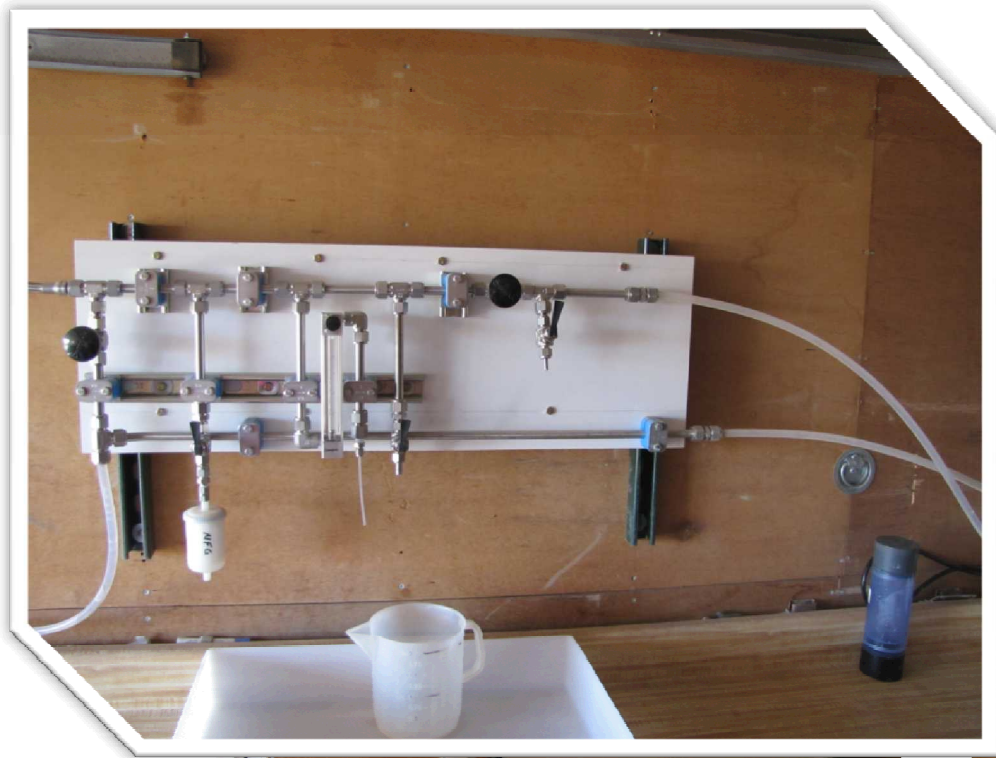
AFTER



# Other Experiences

- Groundwater Sampling Tour
  - Watched a team of people collect water from a well and prep it for sampling of different chemicals and pollutants.





Filter



# Thanks!

- Cheryl Garcia, STAR Program, and all of the other SIP staff
- Co-workers and other Sandians
- Sam

... Any Questions??