The Cloud Obscuring Green-Tech's Revolution Road

The road to the new low-carbon economy might require a detour through China.

They say every cloud has a silver lining. Well, in the case of energy, it seems that every silver lining has a cloud.

The Mountain Pass mine in California's Mojave Desert once dominated the mining of rare earths, essential ingredients in many green technologies. Now China dominates, but could others make inroads? (USGS)

Fossil fuels are great sources of energy — they have high-energy density, transportability, relative abundance, and are easily burned [pdf]. But alas, as we all know, there are problems: mining devastation, oil spills, air pollution, greenhouse gas emissions. And so the search for other, cleaner energy sources is on.

So Far, No Perfect Alternative

Hydropower? Clean as a mountain stream, but the dams can cause serious ecological problems.

Nuclear? Really hot — all that high-voltage power without greenhouse gas pollution. But what about sticky little issues like safety, nuclear waste, and nuclear proliferation?

Biomass and biofuels? They look good on paper, but the specter of accelerated deforestation and competition with the production of foodstuffs have added a lot of caveats to the story.

Electric cars? Zippy, but mass production will require lots of lithium for their batteries.

Wind turbines? A gas, so to speak, but what about the noise and the birds and the eyesore factor.

Some say there's always fusion, but what they really mean is always sometime in the way, way future.

Now another problem with the new green technologies is emerging — rare earth elements.

The Elements Known as Rare Earths

Depending upon which chemist you ask, rare earth elements consist of either:

- the so-called lanthanide series (elements having atomic numbers from 57 [corresponding to lanthanum] to 71 [corresponding to lutetium]) or
- the actinide (elements 89 to 103) and lanthanide series.

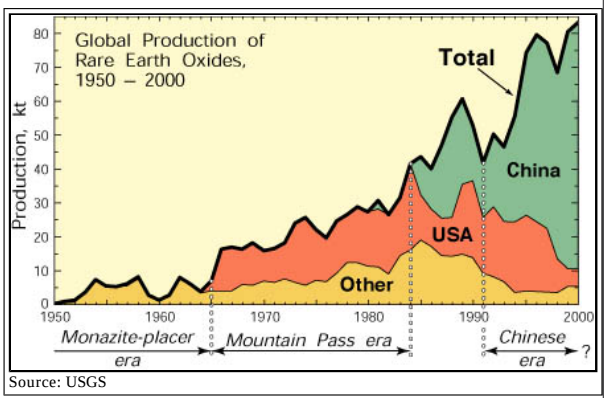
For our story, only the lanthanides are relevant, so let's focus on those, along with scandium and yttrium. (More on rare elements here and here.)

Despite their name, these elements are not rare. They are orders of magnitude more abundant than the really rare gold and platinum, say.

Their rare-earth moniker comes from the fact they rarely show up in concentrated form in a specific mineral or vein. Instead, they are found in very small concentrations just about everywhere, making it very difficult to extract them in large amounts without lots of expense.

In the 1950s and 1960s most rare-earth mining occurred in South Africa, India and Brazil where the elements were primarily extracted from the mineral monazite (see photo). But starting in about 1965, the United States began to dominate the rare-earth production from mines in Mountain Pass, California.

Two decades later, China became the dominant player in rare-earth mining — at great environmental cost. Today, China is responsible for about 97 percent of the globe's rare-earth production, according to a recent report in the journal *Science*.



Source: USGS

Rare Earths and Green Tech

As luck would have it, rare earths are essential to many of the new green technologies we're betting on to launch the new low-carbon economy. For example:

- A Prius uses more than two pounds of neodymium in its electric engine and roughly 20-30 pounds of lanthanum in its battery.
- Samarium and neodymium are essential materials for high-powered magnets used in electrical generators used by wind turbines.
- Europium and terbium are used in electronic displays like LEDs.

And here's the rub. As the applications — and thus the demand — for rare earths have grown, their production has not.

One consequence: the price of rare earths has skyrocketed. (Terbium for example can sell for as much as ~$150 a pound.)

Another consequence: China is gaining more and more control over the world's ability to go the green-energy route through its total dominance of the rare-earth-element market.

To meet its own growing need for the stuff, Beijing has restricted exporting rare earths — shrinking them from 75 percent of total domestic production in the early 2000s to about 25 percent today. Between 2002 and 2008 China's total production of rare earths grew from about 85 to 140 thousand metric tons per year from but their export declined from about 60 to 40 thousand metric tons per year.

American Response?

Could we be trading a dependence on Middle Eastern oil for a dependence on Chinese rare earths? Not necessarily.

For one, China doesn't have to have a rare earth monopoly. While most of the world's oil lies under Middle Eastern sands, we've got rare earths (see for here example) — the problem is getting at them economically.

With rising demand and prices, interest in mining for rare earths here in the USA is growing, In fact, ramped-up mining operations for rare earths in Mountain Pass are scheduled to resume in 2012, while exploration of other domestic sources is picking up.

But their extraction and processing, like all mining, have environmental costs — such as the creation of moonscapes, tailing ponds and toxic-waste streams, to name a few. A longer term solution most likely lies with research and development. And how well are we doing on energy R&D? Not so well — just check out Tom Friedman's columns on the subject.

And here's what Karl A. Gschneidner Jr., from the Department of Energy's Ames Laboratory, had to say in a recent Congressional panel hearing: "rare-earth research in the USA on mineral extraction, rare-earth separation, processing of the oxides into metallic alloys and other useful forms, substitution, and recycling is virtually zero."

The good news is that "virtually zero" is not literally zero. And there's that silver lining.

Comments Disabled after 30 Days