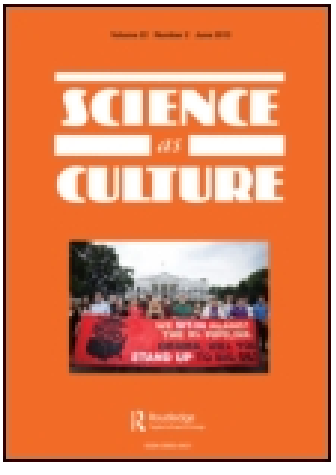

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Fossilizing Renewable Energies

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Fossilizing Renewable Energies

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KEY WORDS: renewable energy transition, rare earths, mining, soft energy path, geopolitics, sociotechnical systems

Introduction

In 2009, a story began to emerge in the business and financial media on a looming threat to green energy futures (Bradsher, 2009; Indiviglio, 2009; Mason, 2009; Saefong, 2009). The Chinese government was reportedly contemplating new restrictions on their exports of rare earth minerals. Rare earths constitute a group of 17 elements in the Periodic Table, the 15 lanthanides and 2 of their close cousins, yttrium and scandium. They are crucial for making batteries and permanent magnets used in wind turbines (Figure 1), electric and hybrid cars, photovoltaic thin films and fluorescent lights. Since China accounted for 95% of global rare earth production, limits on Chinese exports would stymie the development of green energy as well as numerous other civilian and military industries that relied on rare earths. Business analysts urged Western governments to pay heed to this resource crunch and take action.

What does this story about trade politics and an obscure group of minerals signify for sustainable energy transitions? I argue that renewable energy (RE) technologies are becoming fossilized. As the socio-political-commercial-material networks underpinning the production of many RE technologies are made visible, current configurations of RE systems start to resemble the fossil fuel regime they are supposed to supersede. Amory Lovins famously distinguished "hard" energy paths rooted in fossil fuels, nuclear power and geopolitical power games from "soft" paths that would be "flexible, resilient, sustainable and benign" by virtue of their relying on the sun, wind and vegetation (Lovins, 1976, p. 198). It is no

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longer possible to fix our gaze on the point of power generation (clean, emission-free) and ignore wider socio-technical dimensions which are all too familiar in the case of fossil fuels but which are only now starting to be examined for RE (Walker and Cass, 2007). In this essay, I will briefly sketch the *political economy* of material supply and the *socio-environmental* aspects of RE technology manufacturing, using rare earths as a starting point. Informed by how science and technology studies (STS) scholars have reconnected the social and political to the technological (Winner, 1986; Shove and Walker, 2007; Pfotenhauer *et al*., 2012), we can go beyond questions posed in the business media about the adequacy of rare earth supply to ask what arrangements make supply possible in the first place. My aim is to stimulate greater discussion of the moral logic of RE and the implications for energy futures.

The political economy of materials

Geopolitical power structures and strategies together with nation-state capacities to police installations within their borders provide the foundations for the extraction, processing, distribution and use of oil and gas. While this national security pillar revolves around the means to enable access to and/or control of resources, the increasing financialization of markets means that claims of resource scarcity cannot be taken at face value as apparent "shortages" may be deliberately created in a process of speculative investing (Hildyard *et al*., 2012). RE technologies are now similarly implicated in the world of national security machinations and speculative finance.

Media stories on rare earths use an analogy with Big Oil, painting China as the "Saudi Arabia of rare elements" (Saefong, 2009), the centre of a "new OPEC for green energy" (Indiviglio, 2009) holding Western environmental aspirations hostage, or key player in a "new Great Game" (Mason, 2009). Made popular in Rudyard Kipling's novel *Kim*, the Great Game originally referred to the nineteenth century conflict between Britain and Russia vying for supremacy in Afghanistan and Central Asia. Rashid (2000) has described a "new Great Game" in the same region with nation-states competing on behalf of major corporations for control of oil and gas pipelines. BBC journalist Paul Mason offers a new twist, arguing that China's new multi-resource strategy is reshaping the oil-centred global economy, with rare earth mining as one locus of yet another Great Game in which the USA and its NATO allies are playing catch-up.

How did China come to be so dominant in the rare earth metals industry that the USA is at risk of "trading a troubling dependence on Middle Eastern oil for a troubling dependence on Chinese neodymium" according to one American energy adviser (Margonelli, 2009)? Neodymium is used in the strong permanent magnets of modern electric motors. Although this neodymium-iron-boron magnet was invented by General Motors in the early 1980s at a time when the Mountain Pass mine in California supplied most of the world's rare earths, the

Figure 1. Wind turbines, Thornton bank, Belgian coast of the North Sea. Credit: © Hans Hillewaert/ CC-BY-SA-3.0 The photographer is not responsible for the arguments presented in this paper. Source: http://en.wikipedia.org/wiki/File:Windmills_D1-D4_%28Thornton_Bank%29.jpg

story goes that it was Deng Xiaoping who recognized the strategic value of China's reserves in the Bayan Obo mine in Mongolia. As China stimulated domestic efforts in mining and ore processing and flooded the global market, rare earth prices collapsed in the 1990s and mines elsewhere in the world went out of business. In the 2000s, as China developed its own green energy strategy and aimed to attract high value-added manufacturing to locate within its borders, the government successively lowered export quotas despite—or because of—increasing demand from elsewhere in the global economy. This then has led to the current resource crunch and high prices according to the media narrative.

In response to this perceived threat, the US Department of Energy (2011 updating their 2010 report), the UK House of Commons Select Committee on Science and Technology (2011) and the Joint Research Centre (JRC) of the European Commission (JRC, 2011) published assessments of the implications of "critical" or "strategic" metal shortages for low-carbon futures. With the exception of the UK report, these are cast almost entirely in the framework of national security with ways of securing resource supply being the foremost concern. These include options for diversifying supply from sources outside China, improving recycling of metals from industrial waste and R&D for exploring substitutes to rare earths. The Mountain Pass mine in California which closed a decade back is supposed to be re-opening in 2012 and there are reports of Australia and India aiming to re-enter the rare earth production sector with government support. The language of geopolitical competition pervades these efforts as a minister framed India's new initiative in deep-sea mining of rare earths as following China's lead in staking a claim to the oceans for meeting the country's "critical and strategic needs" (Park and Padma, 2012). The *Wall Street Journal* describes India's strategy as driven not only by economic considerations but also by political rivalry with China (Mukherji and Wright, 2012). Likewise, in 2010, the Chinese government blocked supply of rare earths to Japan in the context of a territorial dispute over the Senkaku Islands; Japan has in turn looked to develop partnerships with India to reduce its dependence on Chinese imports.

As well as seeking alternative sources of supply, countries have pursued politico-legal strategies around rare earths not dissimilar to those related to fossil fuels. Notably, the US, EU and Japan have filed a joint case to the World Trade Organization challenging Chinese restrictions on rare earth exports. *We've got to take control of our energy future and we cannot let that energy industry take root in some other country because they were allowed to break the rules*, President Obama declared ominously at the press conference announcing the case (BBC, 2012a). In this geopolitical-geoeconomic discourse, there is complete silence over the environmental and social impacts of rare earth production which as we will see shortly are becoming impossible to ignore.

Yet, focusing on nation-state strategy should not detract from the activities of corporations in the form of lobbying or in the metals market itself. Just as fossil fuel companies have a history of subsidies and networks reaching into the heart

of government, rare earth groups also seek to influence state policy. One example is the lobbying of the US Congress to finally pass the Law of the Sea treaty which would create the legal stability for investing in the risky and expensive business of mining the deep-sea bed (Moffett, 2012). The very story of a bottleneck in rare earths is also part of the "talking up" (and down) of share prices through which financial markets that shape green energy (as much as oil) operate. Media coverage is an intrinsic part of this political-economic landscape, stimulating reactions from government and the RE industry, and contributing to the volatility of rare earths prices. Indeed, one financial analyst explicitly links spikes in rare earth share prices to rise in investment demand stimulated by newspaper articles on China's export restriction policy (Hamlin, 2010). Scandals abound over rare earth companies listed on the Alternative Investment Market of the London stock exchange but without licenses to extract the metals and which collapsed after the bubble briefly burst. The story of China-versus-the-Rest can also be overdrawn as we see US companies like Molycorp acquiring Chinese rare earth firms and predictions of China moving to net-importer status on rare earths by 2014 (Reuters, 2012). So, while a socio-technical perspective requires making visible the political economy of metals required for RE technologies, it is important not to naturalize the narrative of resource crunch as if resource availability and national control were the only issues at stake for green energy futures.

Socio-environmental aspects of material supply

The limitations of a resource supply perspective become starker once we consider the social and environmental aspects of mining and ore processing. The pursuit of national energy security is creating new scarcities and insecurities for millions of people; policies for extraction and circulation of oil, gas and coal are resisted by a growing number of communities (Hildyard *et al*., 2012). The UK House of Commons report examines the similar costs associated with mining rare earths and other metals, though their US and EU counterparts on strategic metals are silent on the matter.

Rare earths, it is frequently pointed out, are not rare at all; the adjective originates from the early-mid 1900s when they were rarely extracted even from ores already mined for more common metals such as iron. At the time, it was considered uneconomic to mine for and process rare earth elements. But commercial judgment can change as seen in the 1950s when new uses emerged for rare earth metals, market demand that increased significantly after the invention of permanent magnets in the 1980s. Likewise, with the higher prices stimulated by recent concerns of a resource crisis, there is greater incentive to pursue the more challenging options, according to the Royal Society of Chemistry in its submission to the House of Commons select committee. Or, as a mining company representative put it in response to a question from the House about whether there was a shortage of critical metals, *in practice, you just dig deeper* (House

of Commons Select Committee on Science and Technology, 2011, p. 19). Yet, as the House of Commons committee recognizes, digging deeper will mean higher energy and environmental costs. The parallels with Peak Oil where reserves are apparently getting harder to profitably access—but where commercial judgments can change if the economic and environmental risks are deemed by investors to be worth bearing irrespective of wider resistance and if nation-states facilitate such decisions—are too close for comfort.

Mining and processing rare earth metals are widely noted to be a "nasty, dirty and environmentally risky process" to quote a UK Minister who gave evidence to the House of Commons Select Committee on Science and Technology (2011, p. 21). For obvious reasons, this has been picked up especially by those on the political right who are ideologically opposed to action on climate change. In the UK, it is the rightwing tabloid, the *Daily Mail* which has done first-hand reporting on the effects of rare earth mining in China on communities highlighting the impact of highly toxic residues of rare earth processing on contamination of air, water, farmland and the bodies of people living in the vicinity (Parry and Douglas, 2011). Indeed, the need to impose stricter environmental standards in its rare earths industry is the chief reason cited by the Chinese government for export restrictions. A recent White Paper highlights severe damage from the mining, dressing, smelting and separating of rare earth-containing ores (Xinhua, 2012). The report lists a litany of environmental problems associated with outdated processing techniques: soil erosion, severe pollution of surface and groundwater, acidification, etc., causing reduced crop output, damage to health and a number of accidents and disasters.

But whilst lower environmental standards helped sustain the Chinese rare earths industry's monopoly in the global market, the Mountain Pass mine also had its own environmental problems with processing operations having to shut down in 1998 after leaks of water having tested to contain radioactive waste. While the CEO of Molycorp has spoken of his plans for making the site "environmentally superior, not just compliant" (Margonelli, 2009), the environmental challenge remains a key one for plans to "dig deeper" in the metaphorical or literal sense. The political calculus of national security allows analysts such as the EU's JRC (2011) to simultaneously recognize the environmental challenge for rare earth mining in Europe, *and* to ignore it by suggesting options for "fast-tracking" projects through the regulatory system, or more egregiously, looking to import rare earth concentrates from countries with lower ecological standards. Even the House of Commons Select Committee which is the most robust on the environmental question of strategic metals tends to fall back on the "acceptable environmental burden" of mining as set by national legislation without delving into how this would be defined and in whose interests.

To its credit, the Select Committee considers at length the *social* impacts of mining alongside the environmental, bringing into the picture the largely silent and remote publics of clean energy futures. Glossed over in the UK and EU reports with reference to supply disruptions caused by "political instability" in metal-rich regions of the

world, the Commons report acknowledges more starkly that "people may be displaced from new mining sites; mines can be dangerous environments . . . and violence and conflict can be driven by control of metal resources in nations such as the Democratic Republic of Congo" (p. 29). Such conflicts pit multinational corporations and national governments against local people as we have seen, for example, in the long-running campaign by the Ogoni people in oil-rich Nigeria to hold Shell liable for the environmental impacts of oil spills (BBC, 2012b). Recent protests by environmental activists and local people around a rare earth metal refinery in Malaysia proposed by the Australian company, Lynas (BBC, 2012c) suggest that similar conflicts will soon become inescapable for renewable energy futures.

Conclusion

While I have focused on rare earths, these elements only represent the starting point for unpacking the material supply chain of RE in its wider political, economic and socio-environmental context. Any full-fledged sociotechnical analysis would need to look at *all* relevant metals and resources – and inevitably, the social and environmental aspects of attempts to secure supply.

In conclusion, I want to briefly return to the very idea of RE. At its heart seems to be a cornucopian vision that is strikingly at odds with its association with responsible stewardship of the planet. Where fossil fuels are now recognized as finite resources, the sun and the wind are frequently described as "inexhaustible" sources of power, leaving room for the inference that tapping into these sources is equally cost-free. On closer interrogation, most advocates for RE would make the point that renewables do not offer a free lunch, but rather a set of options that are vastly superior to fossil fuel or nuclear alternatives. Yet, in framing the debate in this way, it appears that the bounty of renewables is being offered up for insertion into the inflexible and unequal set of arrangements of the contemporary system; RE technologies are already being fossilized in the sense of becoming akin to the political economy of fossil fuels. Writing at a time when visions of RE technologies were largely exempt from critical scrutiny by environmentalists and progressives, Winner (1986) presciently questioned the optimism of proponents who believed that RE was *intrinsically* democratic and egalitarian. Winner argued that social outcomes of RE will "surely depend on the specific configurations of both hardware and the social institutions created to bring that energy to us" (Winner, 1986, p. 39). The rare earths story suggests that we still have a long way to go towards figuring out and constructing these alternative sociotechnical configurations.

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