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When materials become critical : lessons from the 2010 rare earth crisis
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Acknowledgements

After reading the first draft of this dissertation my *hooggeschatte promotor* observed that I had used the word 'interesting' far too often. From a scientific writing point of view de-interestingifying the text was for the better, but it did rob my dissertation of the main sentiment I somehow wanted to convey. From the late nights spent on understanding the chemistry of rare earth processing to the many, many discussions on the geopolitical games played by China and admiring the Japanese countryside from inside a Shinkansen, zipping around Japan in pursuit of interviews with experts from all across the NdFeB supply chain. It was all incredibly interesting.

To start I would like to thank those who made this research project possible: Frans Bekkers, who came up with the amazing idea of combining a PhD with a traineeship at a waste management company, Rene Kleijn, for agreeing to be my daily supervisor with all that that entails, and Derk Bol, who made a lot of the legal, financial and administrative things happen. I would like to thank my advisor, Gert Jan Kramer for his patient guidance and inspiration in all matters scientific. I would like to thank my managers, fellow trainees / young professionals and colleagues at Van Gansewinkel, for keeping my feet on the ground and my scientific work firmly rooted in waste. I would like to thank Ichiro Daigo, Shinsuke Murakami and all my other Japanese friends and colleagues for welcoming me in Japan and making my time there unforgettable. I would like to thank Matthijs Vos, for the detailed proofreading of the resilience chapters, and all of the above and others in the industrial ecology, M2i, and broader scientific community for the many extensive and interesting discussions. I would like to thank my great many friends, both in the Netherlands and across the globe, for all the great adventures of the non-scientific kind. I would like to thank my parents, brother and other family members for their unwavering support. And above all I would like to thank my grandmother Zimira. Our frequent visits to natural history museums were the start of my scientific career.

Curriculum Vitae

Personal information

Family name : Sprecher
First name : Benjamin
Date of Birth : 26 July 1985
Place of Birth : The Hague, Netherlands

Education

- Mar 2016 – current: Postdoctoral researcher at the Yale University School of Forestry and Environmental current sciences
- Mar 2011 – Jun 2016: PhD researcher at M2i / Institute for Environmental Sciences (CML), Leiden University Jun 2016 In the area of recycling and resource scarcity, with a focus on rare earth elements.
- Apr 2014 – Sep 2014: Guest researcher at Tokyo University, Department of Materials Engineering. Focus on data Sep 2014 collection, collaborating on paper writing.
- Sep 2013 – Dec 2013: Guest researcher at Delft Technical University, Faculty of Technology, Policy and Dec 2013 Management. Focus on learning dynamic and agent based modelling.
- May 2015 – Jun 2015: Consultancy for UNEP and Royal Government of Bhutan. Environmental impact of paper use and options for improvement.
- 2011 – 2013 : Management traineeship Van Gansewinkel Groep. Training focussed on project management and personal development at the biggest waste management company of the Netherlands.
- 2008 – 2010 : Master Industrial Ecology. Master's thesis: decision modelling of investment opportunities (CML & Van Gansewinkel). Electives: Environmental Biotechnology, Technologies & Economics of Future Energy Systems of Europe. *Faculty of Science, Leiden University*
- Sep 2007 – Jan 2008: Combined bachelor thesis for SMST & psychology in Guayaquil, Ecuador. The influence of industrial wastewater on a large mangrove forest located next to Guayaquil, with a focus on combining environmental sciences and psychology to gain a more complete understanding of the problems surrounding this beautiful nature area. *ESPOL, Ecuador*
- 2004 -2008 : Bachelor Psychology. Specialization: Social & Organisational psychology* *Faculty of Social Sciences, Leiden University*
- 2003 -2008 : Bachelor Sustainable Molecular Science & Technology (SMST). *Faculty of Sciences, Leiden University*

- 1997 -2003 : Secondary education.
Profile: Natuur & Techniek. *Scholengemeenschap Dalton-Vatel, Voorburg*
- 1989 -1997 : Primary education.
Montessorischool Nieuw Vreugd en Rust, Voorburg

Work experience

- Feb. 2009 – now: Freelance journalist and Columnist
Mainly in the Leiden University newspaper *Mare*. At first I mostly wrote articles and reports on subjects related to the university and student life. For the past five years I have a regular column. Amongst others, I also published an article in ‘het Agrarisch Dagblad’, a cover article for the Dutch New Scientist (formerly NWTmagazine) and a travel report on Ukraine for the newspaper NRC.Next.
- 2011 – 2015 : Work experience during PhD
Teaching responsibilities: organising the Minor Sustainability for two years. Lectures on sustainable waste management, life cycle assessment and system dynamics, including guest lectures at other universities, supervising master theses, etc.
- 2014 – now : Volunteer for the ‘Stichting Duurzame Horeca Leiden’
- 2012 – now : Secretary of the interuniversity organisation of environmental science departments.
- 2003 -2012 : Employee Regent Ingredients.
International marketing & sales of food ingredients. Customer visits: amongst others in Hungary, Japan, Colombia, Ecuador, and Curacao. Supplier visits: amongst others in Malaysia, England, Japan, Israel and the USA. Fair attendance: amongst others VitaFoods (Genève), FICChina (Shanghai) and FII (Paris). Development and maintenance of the website and CRM system.
Regent Ingredients, www.regent.nl, Rijswijk, Netherlands
- 2005-2006 : High school lectures on university life.
Visiting high schools to give presentations on SMST and student life in Leiden. *Leiden University*
- Summer 2004, : Sailing instructor Summer camp for children aged 6 to 10.
Zeilschool op de helling, Friesland

* Due to administrative issues with doing two bachelors at the same time I never received my actual psychology diploma. Complete list of grades is available on request.

Publications

- *Quantification of Resilience in the NdFeB supply chain.*
Benjamin Sprecher, Ichiro Daigo, Matthijs Vos, Rene Kleijn, Shinsuke Murakami, Gert Jan Kramer (under review).
- *Framework for identifying resilience in the supply chain of critical materials, with a case study on neodymium magnets.*
Benjamin Sprecher, Ichiro Daigo, Shinsuke Murakami, Rene Kleijn, Matthijs Vos, Gert Jan Kramer. *Environmental Science & Technology*. 2015 49 (11), 6740–6750.
- *Recycling Potential of Neodymium: The Case of Computer Hard Disk Drives.*
Benjamin Sprecher, Rene Kleijn, and Gert Jan Kramer. *Environmental Science & Technology* 2014 48 (16), 9506-9513.
- *Life Cycle Inventory of the Production of Rare Earths and the Subsequent Production of NdFeB Rare Earth Permanent Magnets.*
Benjamin Sprecher, Yanping Xiao, Allan Walton, John Speight, Rex Harris, Rene Kleijn, Geert Visser, and Gert Jan Kramer. *Environmental Science & Technology* 2014 48 (7), 3951-3958.