Abstract for REWAS 2013: Enabling Materials Resource Sustainability

Stock dynamics and emission pathways of the global aluminum cycle

Daniel B. Müller¹, Gang Liu¹, and Colton Bangs²

¹ Norwegian University of Science and Technology

² Umicore

Key Words: Climate change mitigation, stock dynamics, recycling, socio-economic metabolism, material flow analysis (MFA)

Climate change mitigation in the materials sector faces a twin challenge: satisfying rapidly rising global demand for materials while significantly curbing greenhouse-gas emissions. Process efficiency improvement and recycling can contribute to reducing emissions per material output; however, long-term material demand and scrap availability for recycling depend fundamentally on the dynamics of societies' stocks of products in use, an issue that has been largely neglected in climate science. Here, we show that aluminium in-use stock patterns set essential boundary conditions for future emission pathways, which has significant implications for mitigation priority setting. If developing countries follow industrialized countries in their aluminium stock patterns, a 50% emission reduction by 2050 below 2000 levels cannot be reached even under very optimistic recycling and technology assumptions. The target can be reached only if future global per-capita aluminium stocks saturate at a level much lower than that in present major industrialized countries. As long as global in-use stocks are growing rapidly, radical new technologies in primary production (for example, inert anode and carbon capture and storage) have the greatest impact in emission reduction; however, their window of opportunity is closing once the stocks begin to saturate and the largest reduction potential shifts to post-consumer scrap recycling.

The full paper is available in the following journal publication:

Liu G., C. Bangs, and D.B. Müller (2012): Stock dynamics and emission pathways of the global aluminium cycle. *Nature Climate Change*. Published online 07 October 2012.