

**Title:** A quantitative comparison of ecological cycles and circular economy in environmental problems and sustainable solutions

**Setting:** Environmental Impact Assessment (EIA) of substances, products and activities is often carried out in frameworks like Life Cycle Assessment (LCA), Cradle to Cradle (C2C), Environmental Footprinting (EF), Circular Economy (CE) and Industrial Metabolism (IM).

**Gaps:** While very powerful in attracting attention, these qualitative metaphors are difficult to implement in quantitative assessment because data are lacking for the many products, materials and substances involved. In particular, these concepts require extensive bookkeeping with little opportunities to extrapolate from one product, material or substance to another. By contrast, biological metabolism is well-known for nonlinear scaling, with far-reaching implications for all kinds of applications ranging from dosing of drugs to designing nature reserves.

**Objectives:** A simple and transparent model linking flows of water, materials (minerals, carbon ...) to the size systems involved, covering e.g., engines, companies, cities or countries. To that end, you will extend existing models for (a)biotic systems to these social/technological systems. As priorities are set by data availability, we anticipate starting with company or country-based flows of materials, currently set up for circular economy assessment. The model derived will be used to determine similarities between material cycling in ecosystems and economies.

### **Methods**

- 1) Review frameworks mentioned combining keywords like industrial metabolism, circular economy, material flow, scaling, allometrics, ...
- 2) Collect data on material flows for the level (companies, cities or countries) selected
- 3) Select appropriate equations for material cycling from existing models.
- 4) Derive global values for parameters not covered yet.
- 5) Compare biological and technological systems

### **Expected results:**

**Tables and figures:** typically comparing material flows in ecosystems and economies

**Uncertainties and explanations** for the differences and similarities observed in the comparison.

**Format:** Scientific paper.