Urban metabolism and urban mining

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The urban environment as a hub of materials

- Primary materials extraction has tripled over the last 50 years
- This trend shows no slowing down
- Leads to major challenges
  - supply issues
  - waste generation
  - environmental impacts
- Circular economy is introduced as a way out: keeping materials in use will reduce the need for primary production (eat your cake and have it)
- We still know very little about the dynamics of our societal material system
The urban environment as a hub of materials

- What happens to the materials after extraction?
The urban environment as a hub of materials

- Materials extracted from the environment are consumed **and used** in cities
- Urban metabolism looks into material flows in, out and through cities
  - **flow resources** (fossil fuels, agricultural crops) vs **stock resources** (metals and minerals)
  - flow resources are brought in and consumed - no waste or at best back-to-feedstock: this is where the “leakage” is
  - stock resources accumulate in material stocks that can be re-used or recycled
- Cities form a huge **urban mine** of resources accumulated in stocks
  - **stocks drive flows** rather than the other way around
  - the dynamics of these stocks is presently not well understood
  - but very important when planning for a circular economy.
The urban environment as a hub of materials

- Stocks are expected to grow as well as a result of global development
- Stocks may saturate: decoupling of economic growth and material growth

(source: Marinova et al, in review)
Urban mining

- Urban mining: using the stocks in the urban environment as a source for material production
- source: https://blogs.ubc.ca/civl498a/2017/12/19/construction-in-a-circular-economy/
Urban mining

- Geological mining:
  - exploration: is this site potentially interesting?
  - prospecting: how much is in there and in what concentrations?
  - business plan: what will it cost to produce the material out of the ore, and what will be revenues?
  - mining plan: what is needed to start up the mine? (permits, workers, infrastructure, ..)
  - prepare operations
  - start operations

- How would this look for urban mining?
Urban mining

- Urban mining research so far focuses on prospecting: how much is there? Some examples of students’ group research, MSc Industrial Ecology, Leiden/Delft
Urban mining

- Availability of material from urban mine very different
  - presently in use, outflow dependent on stock dynamics (source Deetman et al., in review)
Urban mining

- Market mechanisms quite different and partly unpredictable
- Logistics quite different, new supply chains have to be created
- Recycling processes for the urban mine have to be developed and/or optimised
- Mining companies to take the lead?
Urban mining

- We don’t know what an urban mining system will look like yet
- ... but if we manage to pull it off, it really can make a difference!

(source: van der Voet et al., 2019)

Aluminium production ($10^9$ kg/year)  Related CO2-emissions (kg CO2-eq / year)
Sources


- Sebastiaan Deetman, Sylvia Marinova, Ester van der Voet, Detlef P. van Vuuren, Oreane Edelenbosch & Reinout Heijungs, 2019. Modelling global material stocks and flows for residential and service sector buildings towards 2050. Journal of Cleaner Production, in review

Thank you for your attention