

Urban metabolism and urban mining

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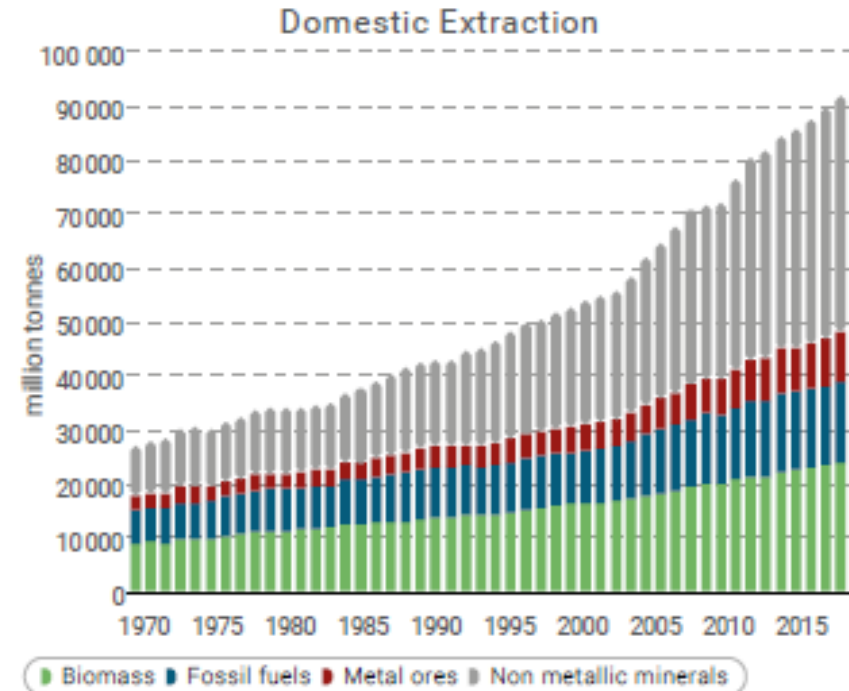


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The urban environment as a hub of materials

- 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

FIGURE 2.7 Global material extraction, four main material categories, 1970 - 2017, million tons. Obtained by totalling domestic material extraction for all individual nations



Source: UNEP & IRP, 2018

The urban environment as a hub of materials

- What happens to the materials after extraction?



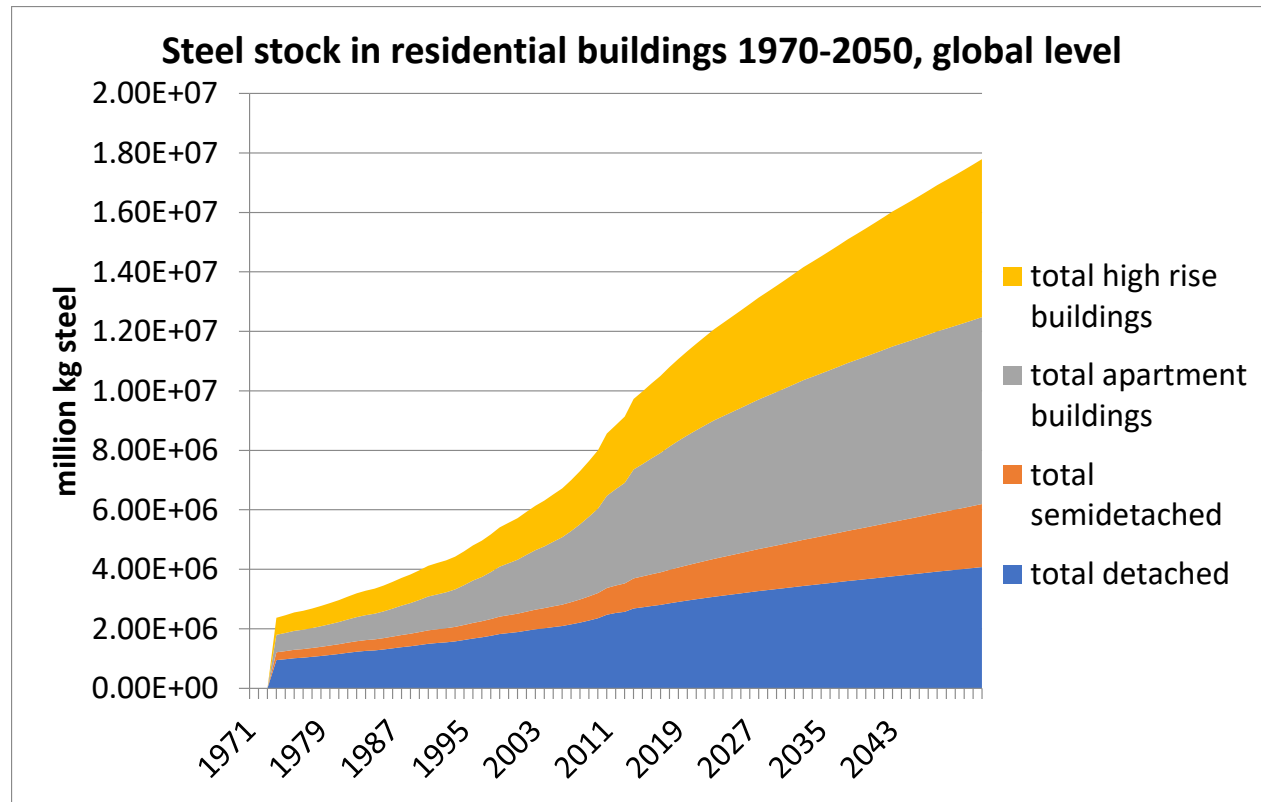
The urban environment as a hub of materials

- 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

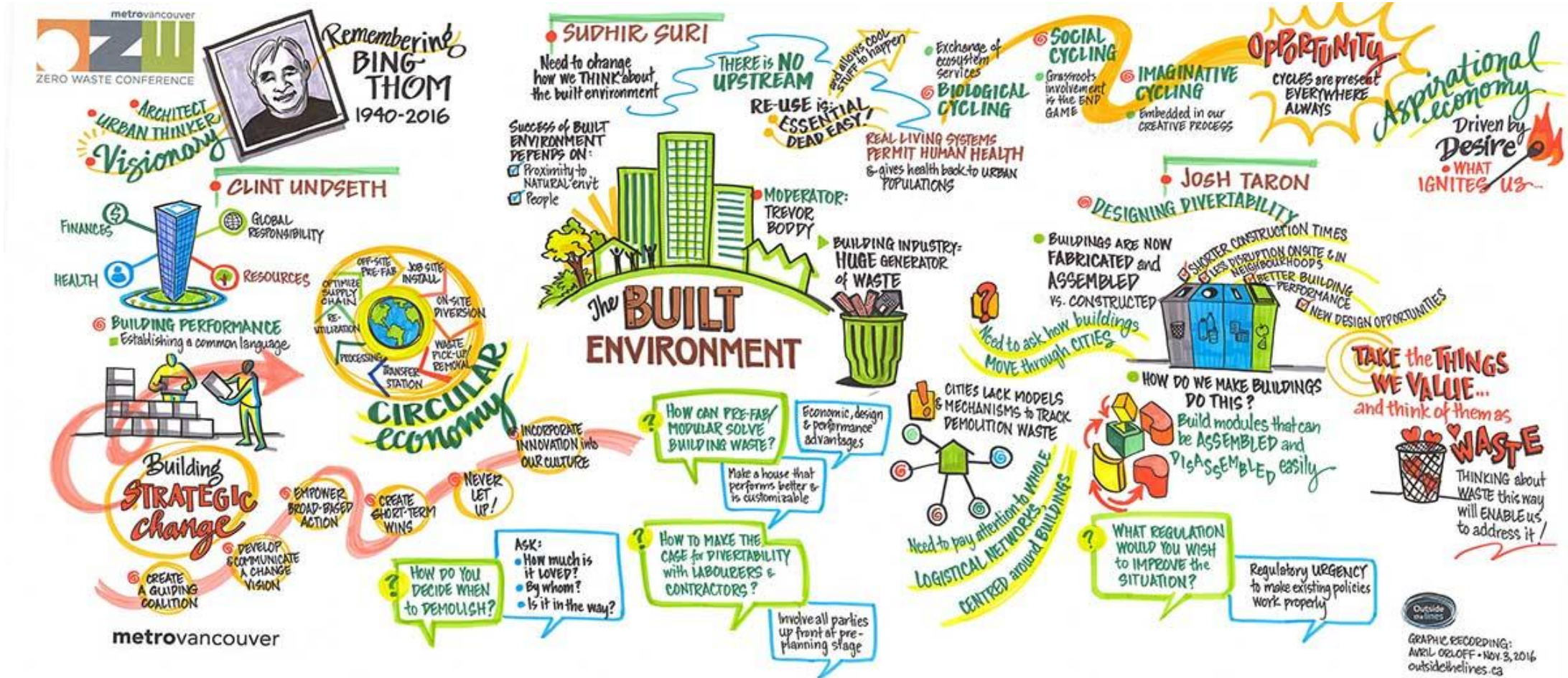
- Stocks are expected to grow as well as a result of global development
- Stocks may saturate: decoupling of economic growth and material growth

(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

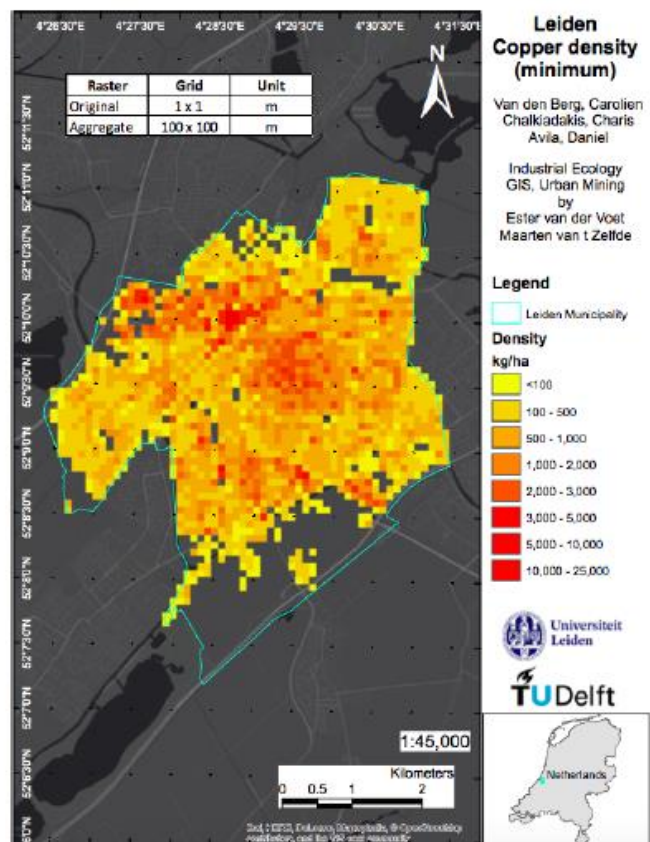
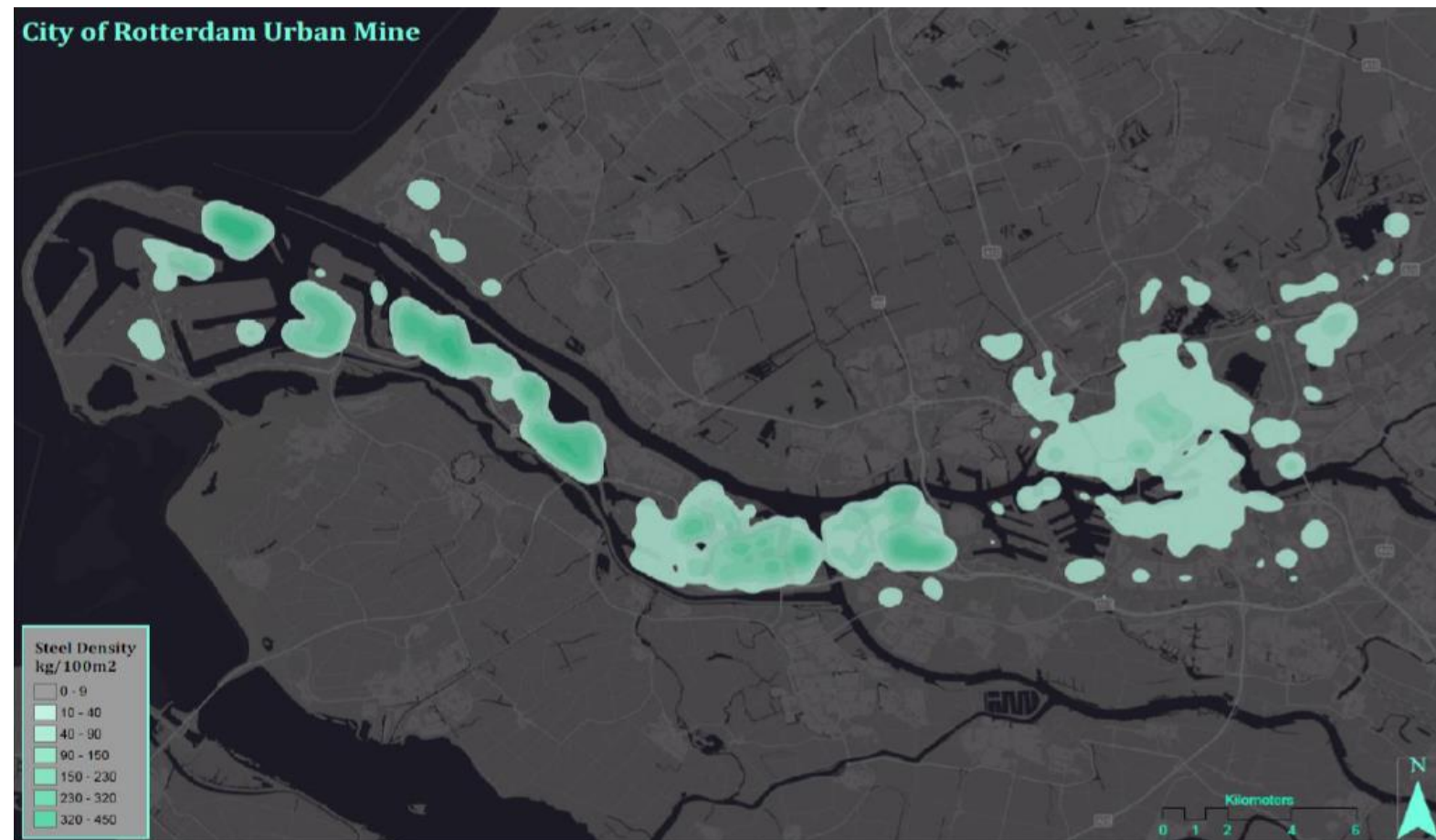
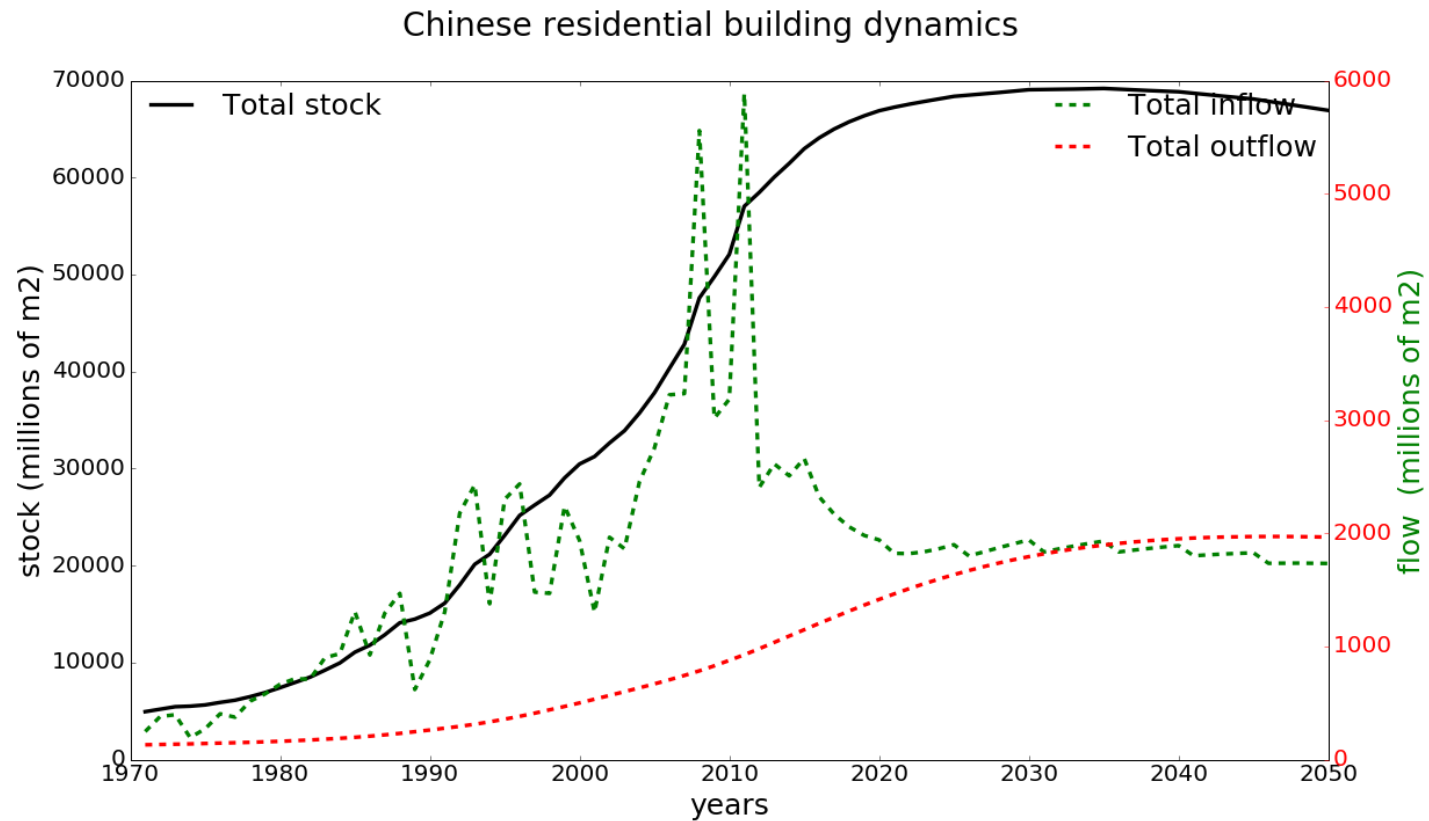


Figure 5: Leiden Copper Density, minimum (Raster 100mx100m)



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

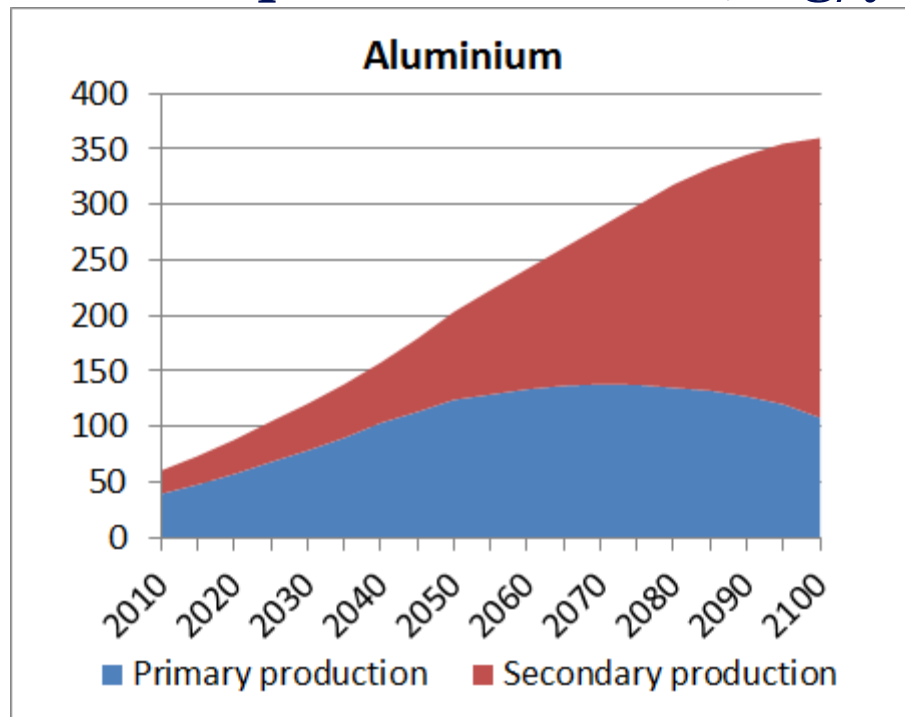
- Mining companies to take the lead?

Urban mining

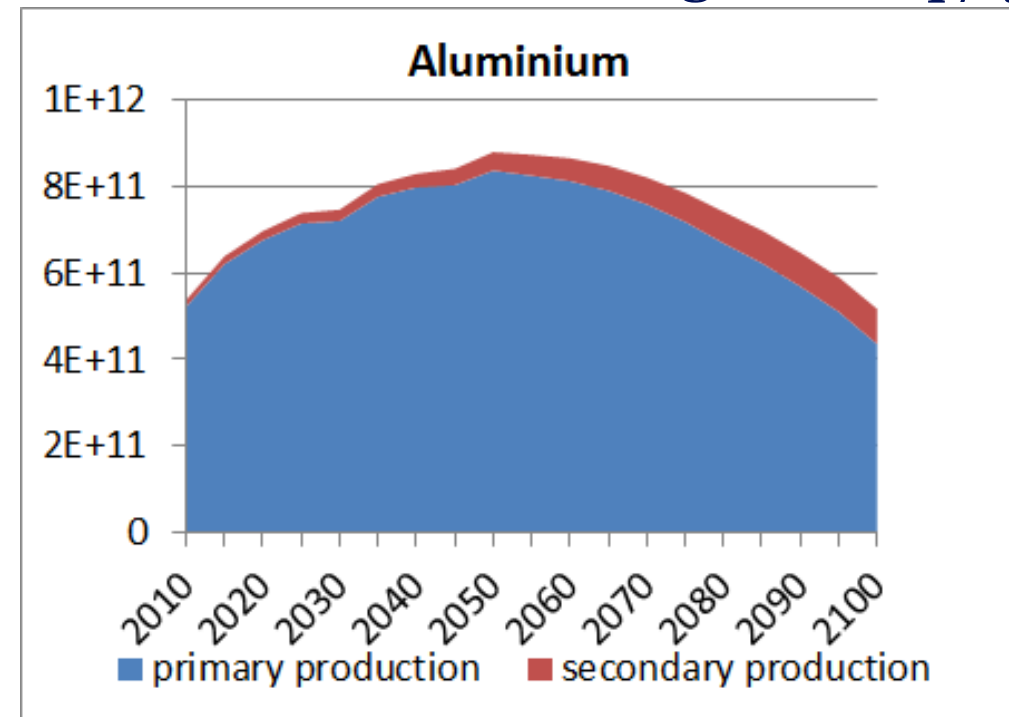
- We don't know what an urban mining system will look like yet
- ... but if we manage to pull it off, it really can make a difference!

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

Aluminium production (10^9 kg/year)



Related CO₂-emissions (kg CO₂-eq / year)



Sources

- UNEP & International Resource Panel, 2019. Global Resources Outlook 2019: Natural Resources for the Future we Want.
- Sylvia Marinova, Sebastiaan Deetman, Ester van der Voet, Vassilis Daioglou, 2019. Global construction materials database and stock analysis of residential buildings between 1970-2050. Journal of Cleaner Production, in review
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- Ester van der Voet, Lauran van Oers, Miranda Verboon & Koen Kuipers, 2019. Environmental implications of future demand scenarios for metals. Journal of Industrial Ecology 23(1) 141-155

Thank you for your attention



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