Resource – Efficiency by better access to R & D

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The resource challenge at 7% growth, no decoupling

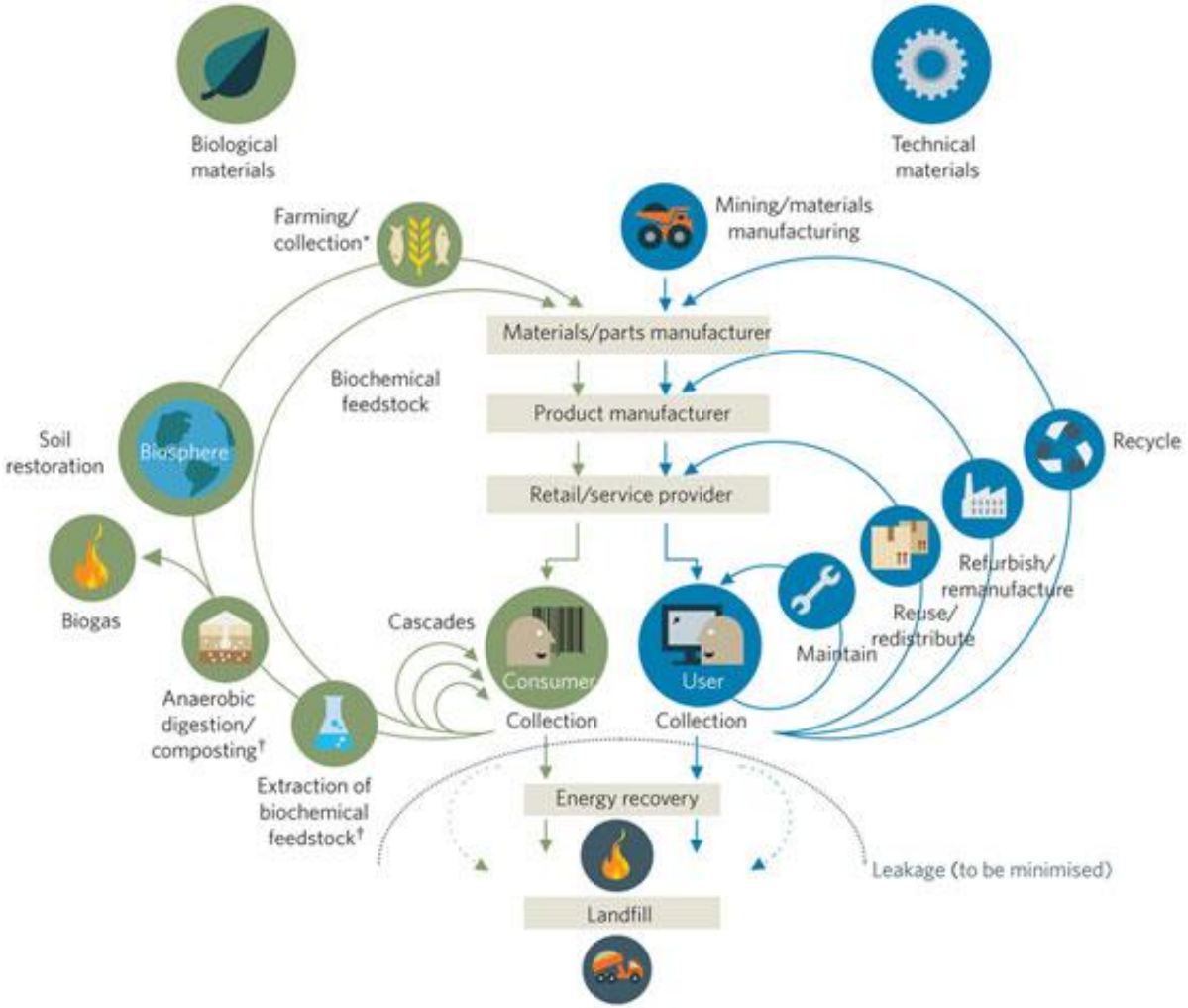
Doubles global economy every 10 years

Annual resource needs would be met for::

- 382 yrs: if the oil barrel would be the size of the earth
- 307 yr: if mining the full earth crust
- 190 yr: if all water including seas would be used
- 131 yr: energy use = if the full solar influx would be captured

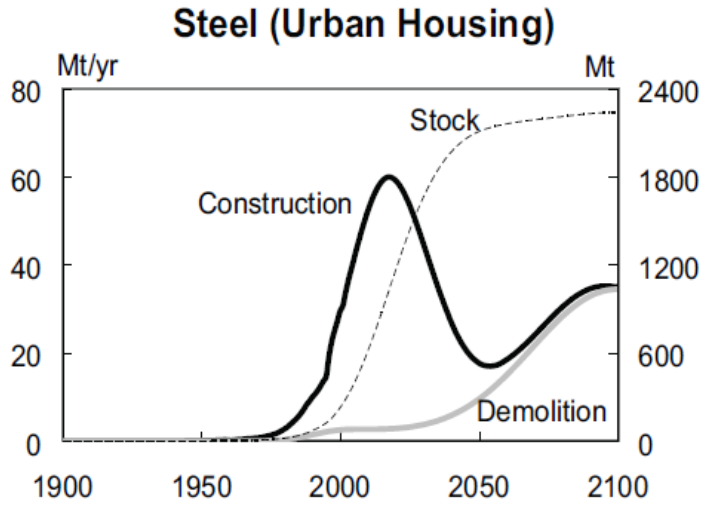
Of course with 2-3% growth the figures look better, but the long-term problem is clear

The long term solution: circularity, as much as possible



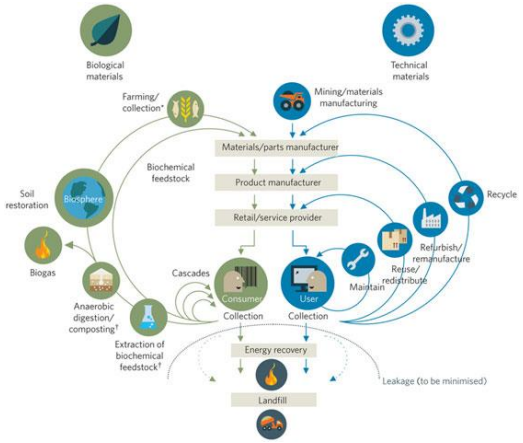
But full circularity does not exist, mining will always be needed

- Growing economies build economic stocks -> need input of primary materials



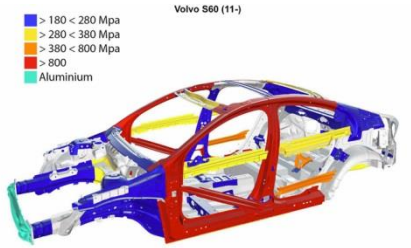
Mingming Hu, CML, 2010, steel in Beijing

- 2nd law of thermodynamics says that closing loops always need energy
- There is always some degradation and hence need for more material input



What businesses can do

- Make production lean & efficient
- Produce smart materials
  - High strength -> low volume, saves energy at use phase
  - With critical materials ‘engineered out’
  - Based on abundant ‘elements of hope’ (e.g. Si, Fe, Al)
- Design products for the circular ecoonmy:
    - Design for re-use
    - Design for component re-use and remanufacturing
    - Design for recycling
- Offer solutions rather than products



Use of high strength steel

Copier remanufacturing

Chemical leasing

There may be hurdles, though

- **Value**: is tangible and intangible value to customer equal or better?
- **Costs**: are cost reduction by less resource use not offset by additional transaction costs, investment/capital costs, a higher risk profile, etc.?
- **Power and dynamics**: do other benefits like a better position in the value chain, higher speed of innovation, learning outweigh problems such as investment in new core capabilities, cannibalisation and loss of existing synergies in the company and value chain?
- **Rebound effects**: do more efficient products lead to higher resources consumption due to market success?

Overcoming hurdles needs experimenting and support

- Open innovation centres supporting innovation
- Supportive boundary conditions set by policy
  - Taxing materials, not labor
  - Taxing and banning cheap treatment like landfill