MODULE 1

Tox-free, circular, and climate-friendly buildings

1.3 Hazardous substances, Circular economy and climate

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Hazardous substances and the circular economy

The 4 stages in Circular economy model materials are:

1. used for as long as possible;
2. reused wherever possible at the end of the intended utilization phase;
3. used for other purposes after the end of their repeated use, if reuse is no longer possible;
4. recycled (downcycling), i.e. the materials are used for the manufacture of new products if reuse or re-utilisation is no longer possible (downcycling).

Stage 1: Extending lifetime

How do hazardous substances affect Stage 1?

- **Chemical Additives** extend product service life but may pose hazards

  - ✓ **Anti-UV Chemicals** protect against UV damage, enhancing durability
  - ✓ **Antioxidants** used to counter oxidation effects, prolonging durability

Anti-UV chemicals with hazardous properties

Hindered Amine Light Stabilizers (HALS)

- Used in paints, coatings, sealants and adhesives

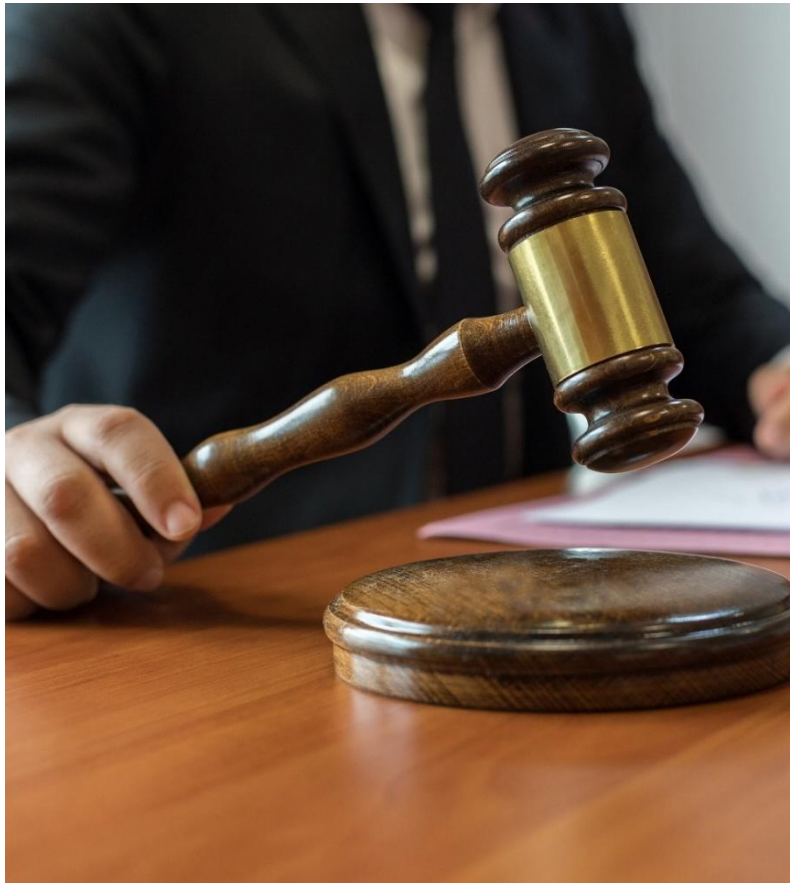
Benzotriazole

- Used in paints, coatings, sealants and adhesives

Stages 2 and 3: Reuse

How do hazardous substances affect stages 2-3?

- **Chemical regulation** is slow.
- New substances often take **10 years** to be regulated after their properties are known.
- **240 substances** are on the REACH candidate list with high concern (SVHS) but are not yet regulated.
- Products containing **SVHC** may face future restrictions, impacting their usability.
- There is uncertainty about reusing products with chemical additives due to **evolving regulations.**



Stages 2 and 3: Reuse

How do hazardous substances affect stages 2-3?

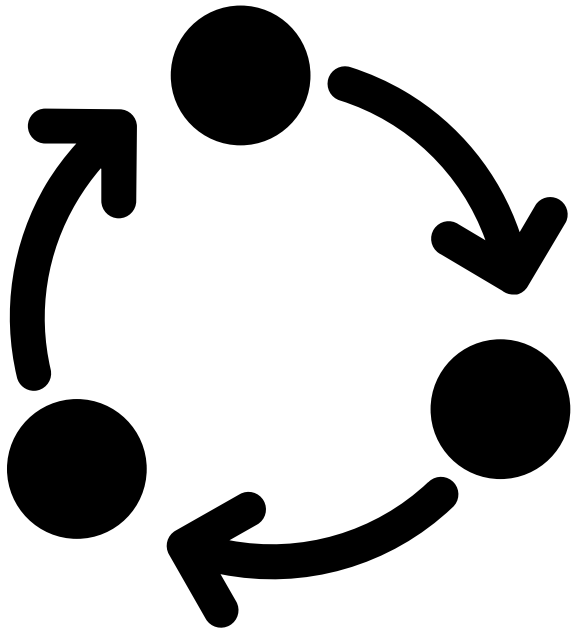
Example Asbestos

- Asbestos was used in various building materials for its fire-resistant, insulating, and non-flammable properties
- Causes **severe health issues**, including lung diseases and lung cancer, breast, and peritoneal cancer
- Today many building elements **contain asbestos**, e.g. windowsills. They could be easily reused in new buildings, but it is prohibited to do so
- **Banned** in new construction in 55 nations

Stage 4: Recycling Recap

How do hazardous substances affect Stage 4?

- **Material purity** is essential for recycling processes
- Chemical additives are generally **not removed** in the recycling process
- Recyclates thus contain an unknown **chemical cocktail** which can hinder their usability/ **recyclability**



Example of satisfactory recycling: untreated solid wood

Why is it good for recycling?

Untreated solid wood is:

- mono-material
- free of hazardous substances

✓ Wood can be shredded and processed into chipboard or wood fibre insulation

Example of unsatisfactory recycling: wood polymer composite

Why is it unsatisfactory for recycling?

Wood Polymer Composite:

- is a composite material – different components can't be separated
- may contain hazardous substances, e.g. glue and polymer additives, etc.

How does the circular economy influence climate change mitigation?

- Climate change results from the **clash** of Earth's natural system with human economic activity.
- Addressing it requires **transformation** of energy, food, cities, production, and consumption systems.
- Addressing human-caused greenhouse gas emissions is essential **to stopping climate change.**
- Achieving net zero emissions demands **transformation of key economic systems** not just energy.

The road to net zero emissions

- Transforming the global energy supply **from fossil fuels to renewables** will reduce emissions by only **55 %**
- Transforming the economic system **from linear to circular** will reduce the remaining **45 %**

Photo by Mathias Reding

Hazardous substances and climate change

- Climate change and chemical pollution are often treated separately, but they are **closely interconnected**.

Hazardous substances contribute to climate impacts

↕

Climate change increases chemical exposure risks

- Understanding these links is essential for sustainable construction and environmental policy.

Photo by Vlad Chețan

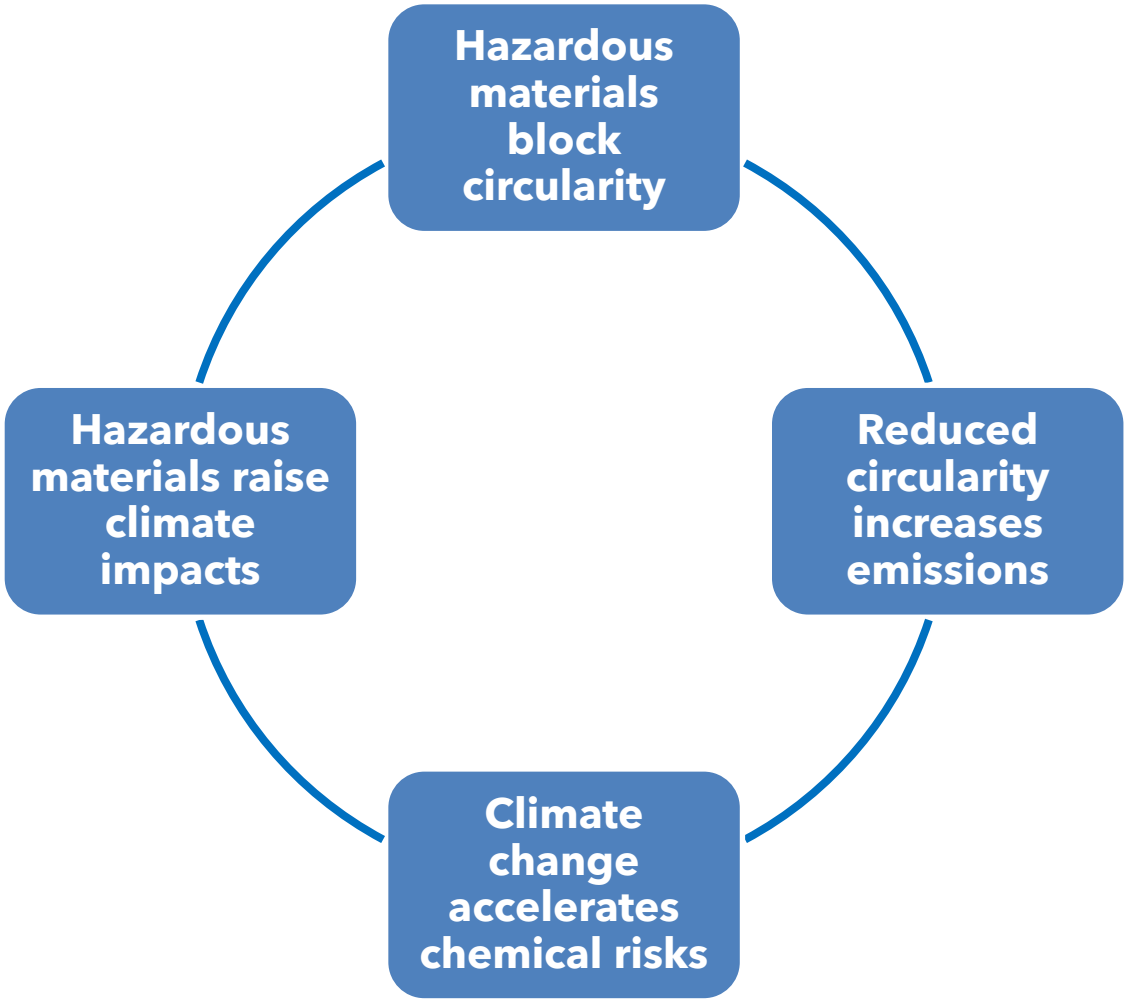
Hazardous substances drive climate impact

- Production of toxic chemicals is **energy-intensive** and fossil-fuel based.
- Toxic materials lead to more waste and **more CO_2 from incineration.**
- **Embodied emissions** rise when designs rely on petrochemical products.

Climate change increases chemical risks

- Higher temperatures accelerate VOC off-gassing indoors.
- Heavy rainfall and flooding spread PFAS, pesticides, and heavy metals.
- UV exposure speeds up degradation of plastics and coatings.
- Warming conditions increase mould growth → more use of biocides.

Interlinkages



Thank you!

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