The background of the slide features a series of horizontal, wavy lines in various shades of blue and white, creating a sense of movement and depth. The lines are more pronounced on the right side of the slide and fade into a solid dark grey on the left.

The Secret Life of Buildings: embodied carbon and the environmental impacts of construction

The Highgate Society-May 2022

1. Why are we talking about this....?

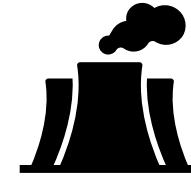
- Planetary Boundaries
- Resource Economics
- Donuts ???

2. Key environmental impacts and metrics

3. What we can do...

4. Materials...a taster...

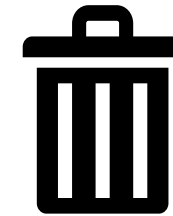
30% of global energy & CO2e emissions



33% of global resources



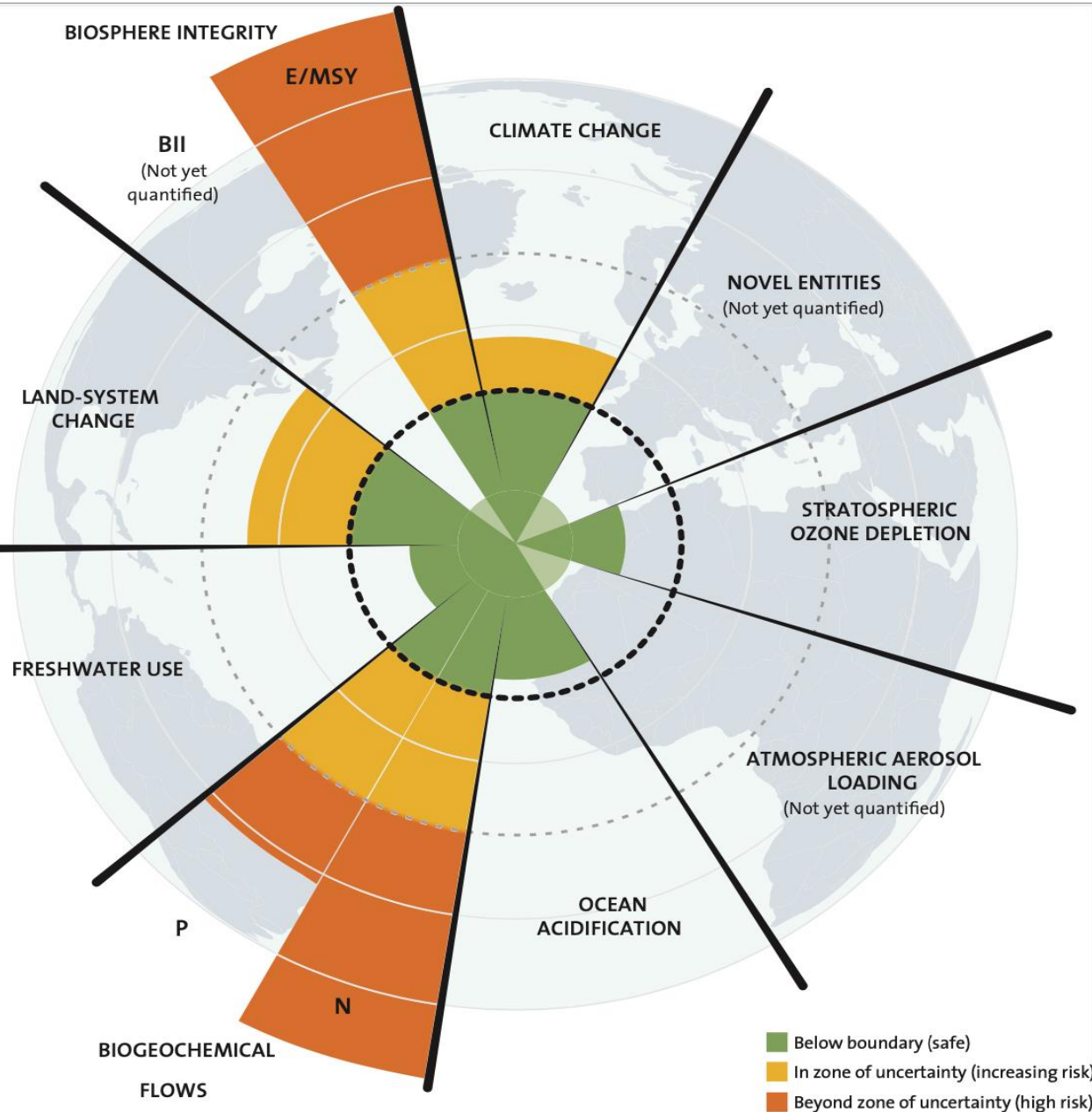
40% of MSW

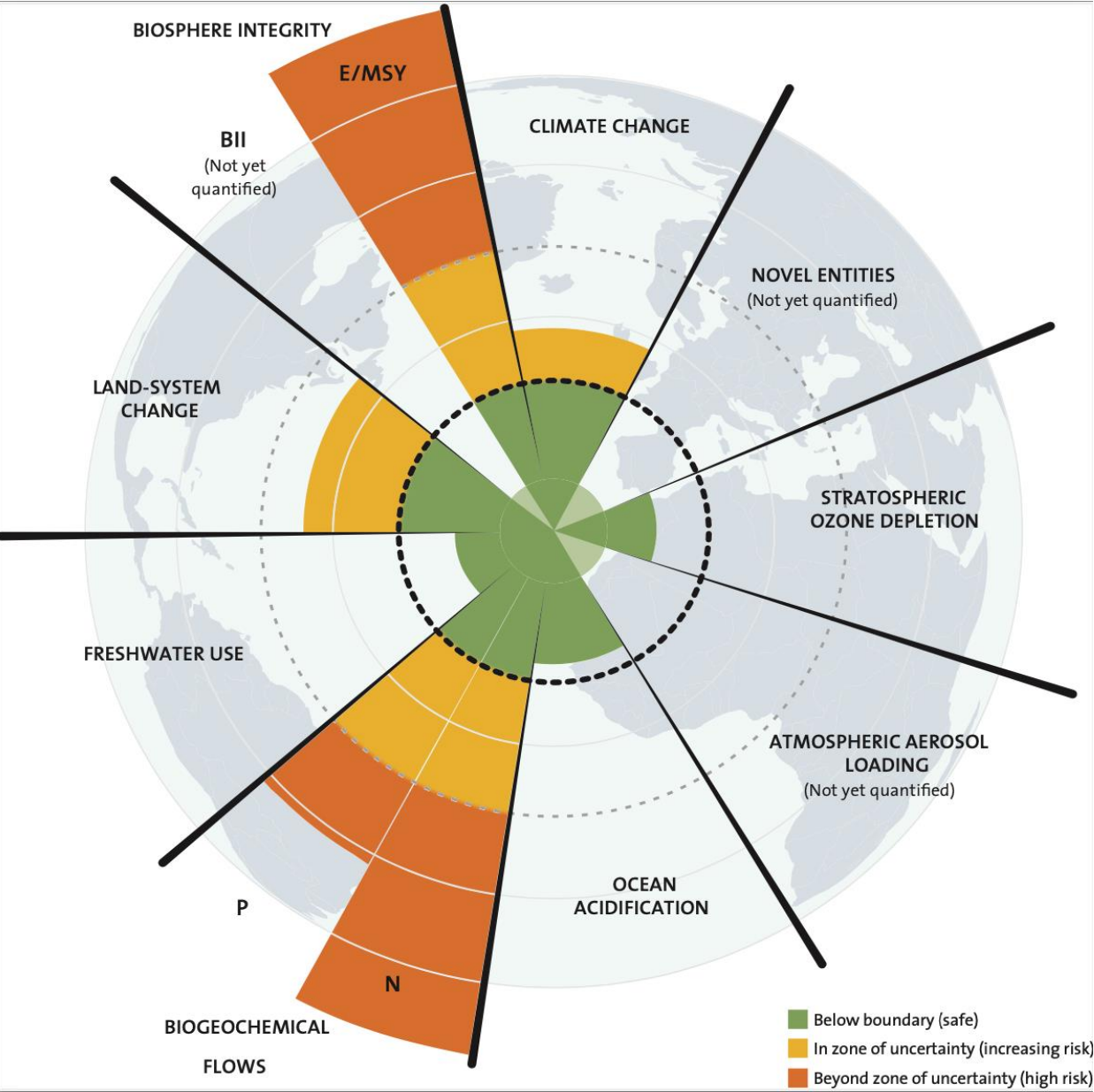


PLANETARY BOUNDARIES

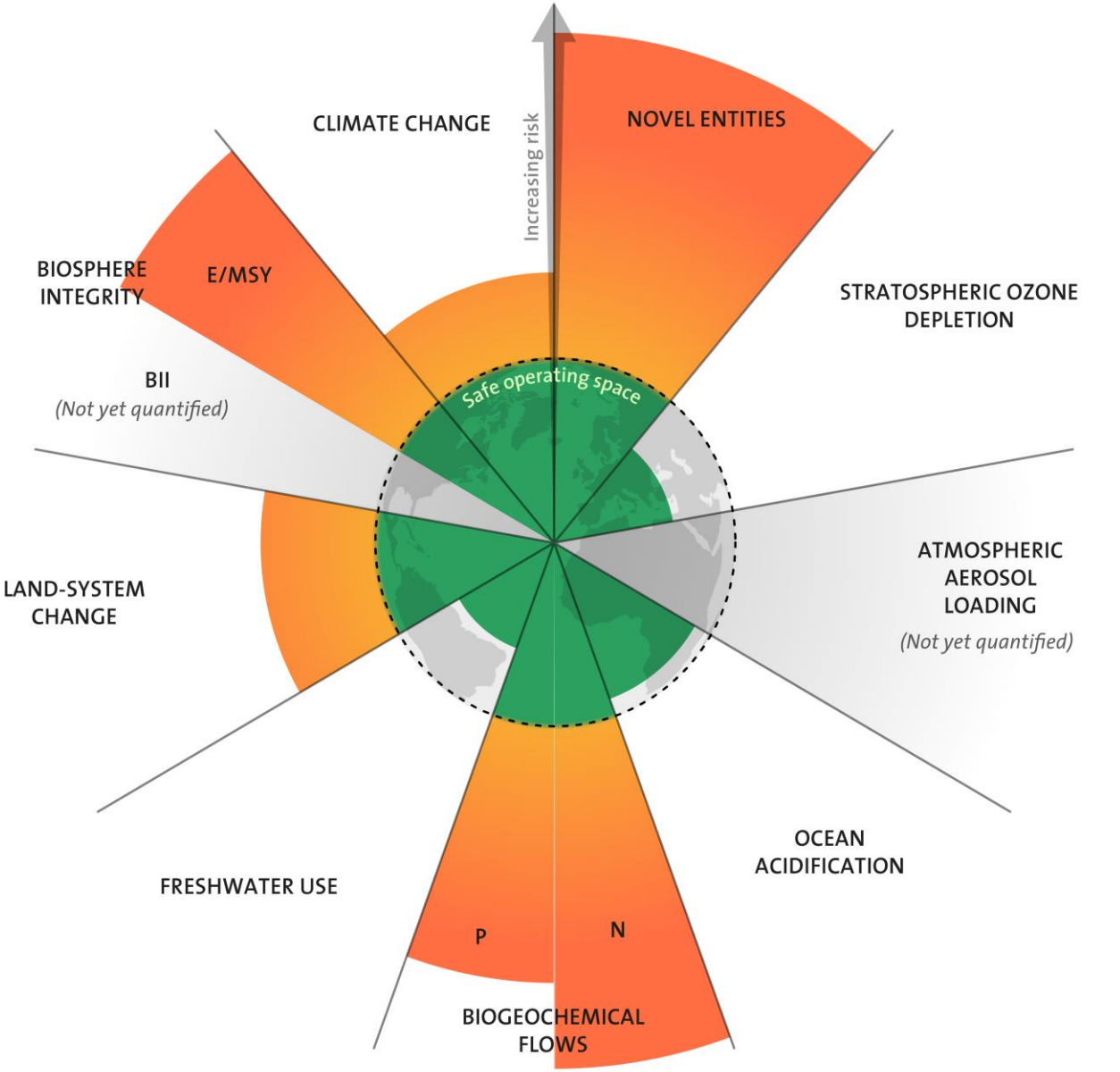
2009 The Stockholm Resilience Centre

- 9 key indicators to measure the **safe operating spaces** for humanity
- 4 transgressions,
- 2 with **high risk** to human welfare





Rockström, J., W. Steffen, K. Noone, Å. Persson, et.al. 2009. Planetary boundaries:exploring the safe operating space for humanity



2022 Persson, L., Carney Almroth, Collins, C.D., Cornell, S., de Wit, C. et.al. 2022. Outside the Safe Operating Space of the Planetary Boundary for Novel Entities

Sustainable Development Goals (SDGs)

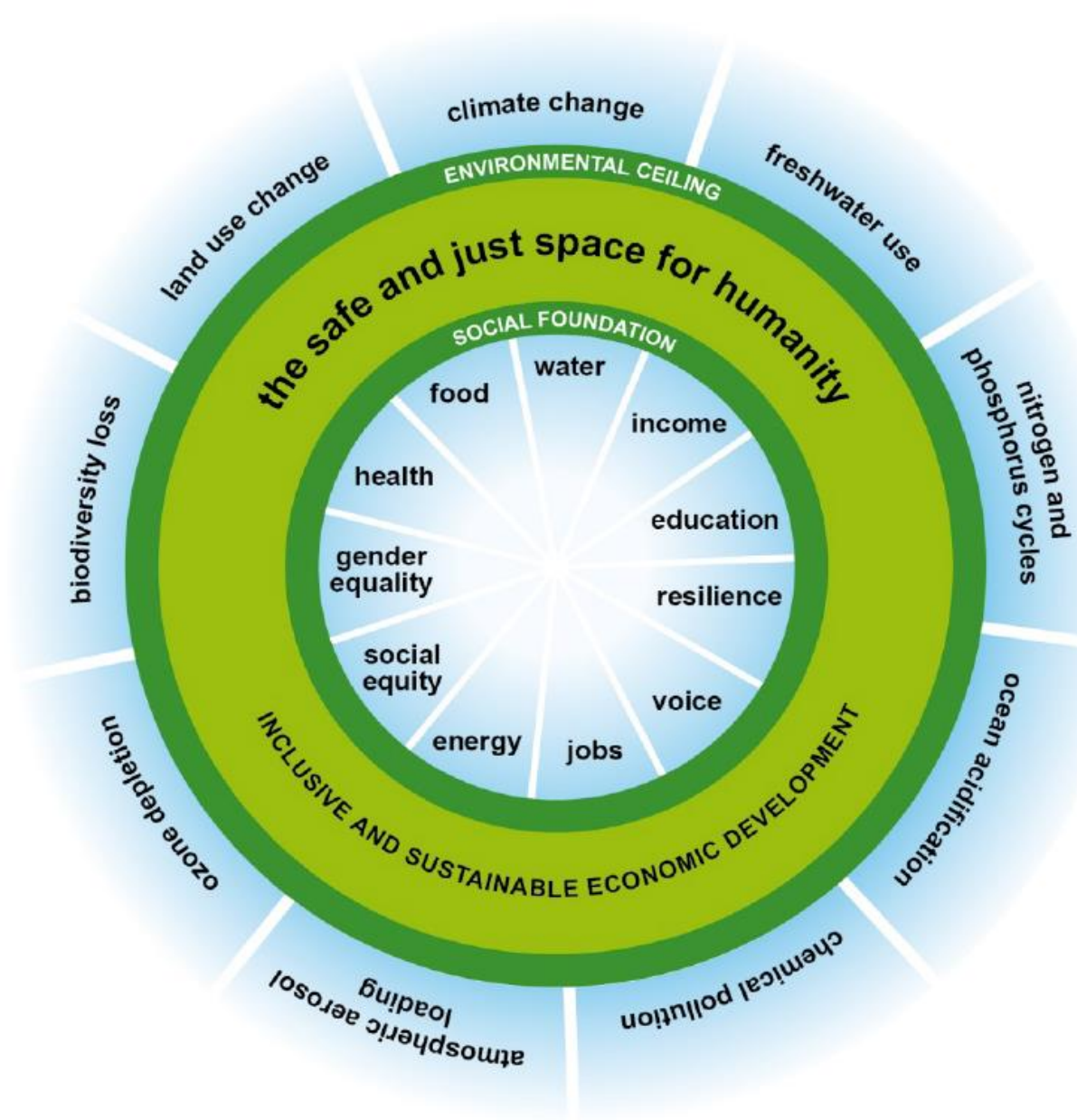


The economics of doughnuts.....



A safe and just place for humanity to thrive in

Kate Raworth; Donut Economics



Source: Oxfam. The 11 dimensions of the social foundation are illustrative and are based on governments' priorities for Rio+20. The nine dimensions of the environmental ceiling are the planetary boundaries set out by Rockström et al (2009b)

Dynamic Demand Increase Projected for 2060

Materials use increase



2011



2060



Metals



Fossil fuels



Biomass



Non-metallic minerals

2011

8Gt

2060

20Gt

14Gt

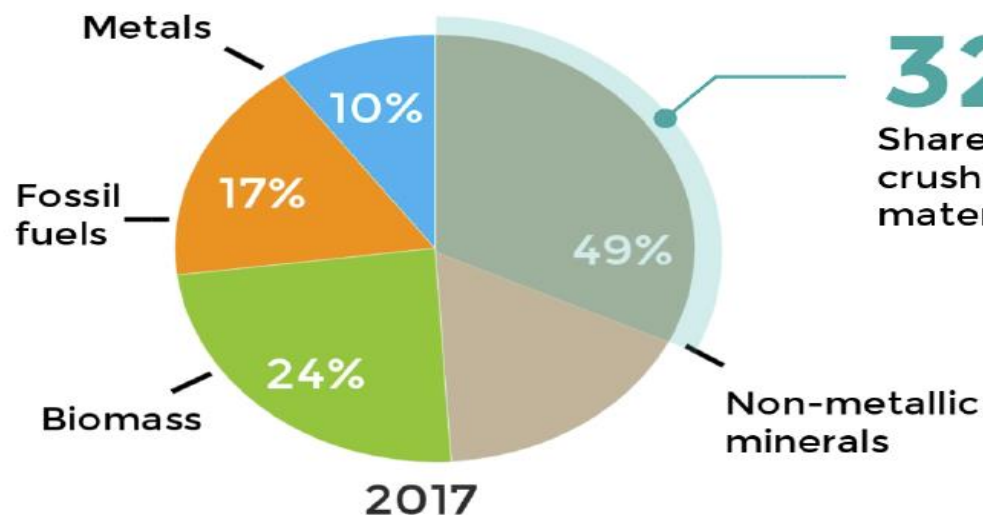
24Gt

20Gt

37Gt

37Gt

86Gt



32%

Share of sand, gravel and crushed rock in total materials use



Construction materials use stabilises in China after 2025

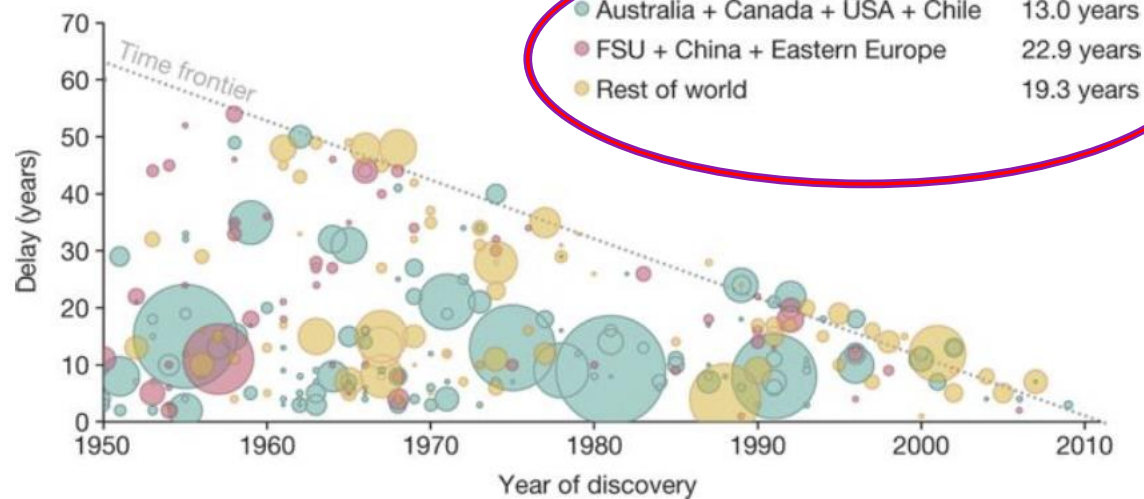


2011

2025

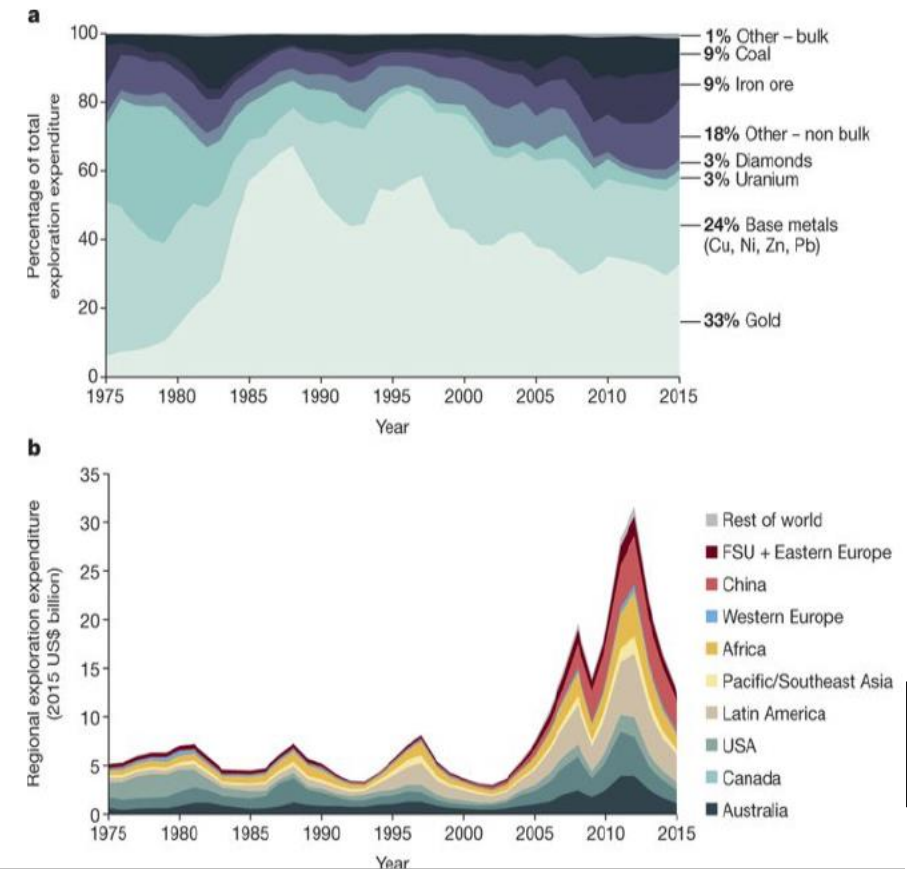
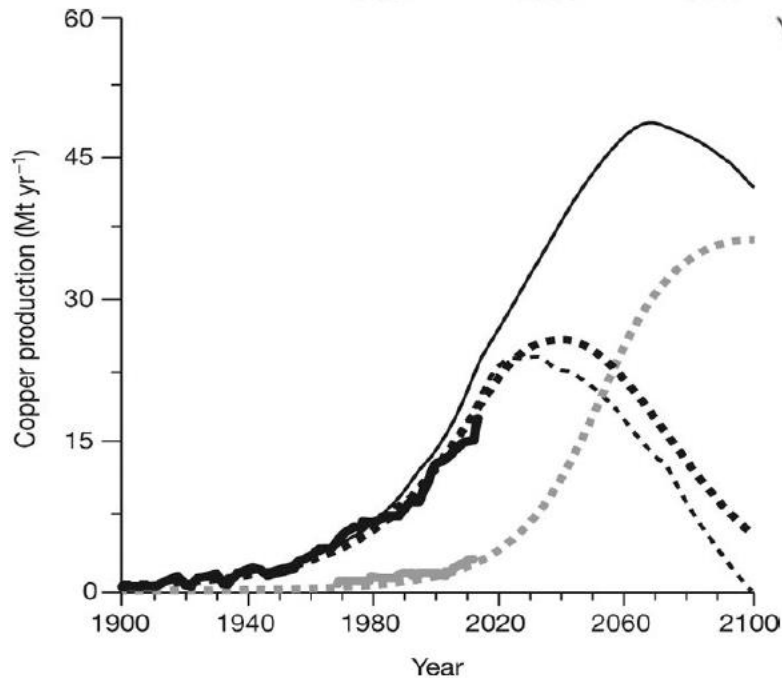
2060

Supply Side Dynamics



Delays in approved copper projects worldwide based on year of discovery

World exploration investment 1975–2015



KEY IMPACT CATEGORIES

1. Climate Change=GWP
2. Resource Depletion=Abiotic Depletion (AD)
3. Human Toxicity=HTP

LCA: Compilation and evaluation of inputs, outputs and **potential** environmental impacts of a products systems throughout its life cycle
(ISO 14040:2006 & 2016)

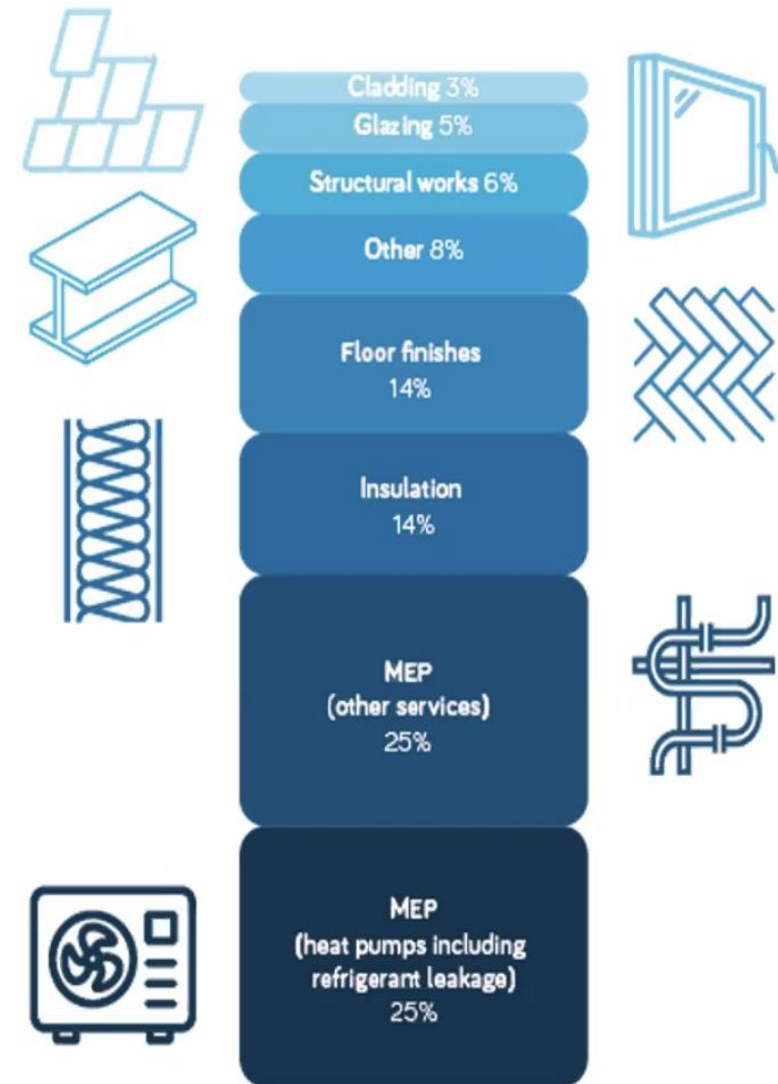
1. Goal and scope definition
2. Functional unit definition
3. Boundary definition
4. Input & Output definition for the product system
5. Impact category and indicator definition
6. Characterisation
7. Normalisation
8. Grouping
9. Weighting

Carbon hot spots

As the majority of the existing frame, foundations and walls were re-used:

- carbon footprint is more heavily geared towards buildings services and finishes.
- Low carbon insulation materials (jute, mineral wool, foam glass) preferred where feasible
- Internal finishes were carefully selected to maximise recycled content and minimise virgin plastics.

The No.1 impact in the scheme is the heat pump specification – this is a necessary pre-requisite to much of the operational carbon saving on the project – but is a rapidly improving area with a large potential for positive impact through robust and careful specification. Teams should specify well and avoid “or equivalent...” products.





Design out waste and pollution
to reduce GHG emissions
across the value chain

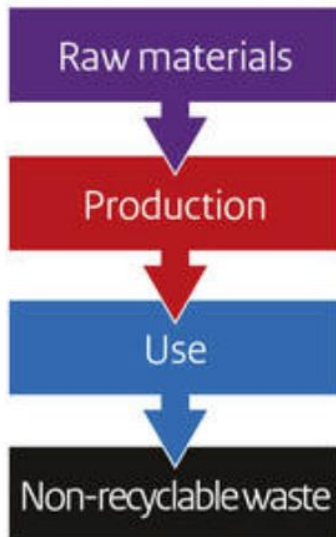
Keep products and materials in use
to retain the embodied energy
in products and materials

Regenerate natural systems
to sequester carbon
in soil and products

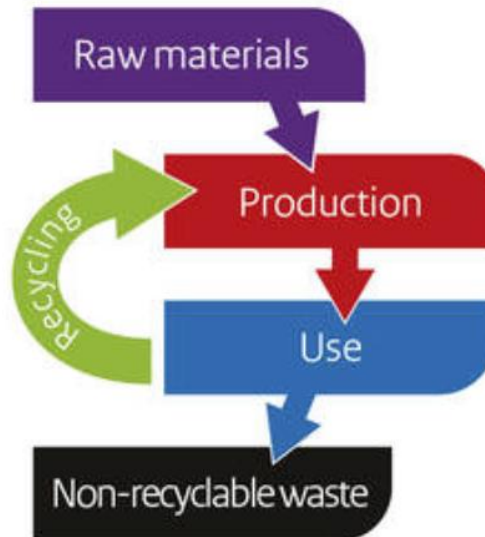
Source: Ellen MacArthur Foundation (2019): *Completing the Picture. How the Circular Economy Tackles Climate Change*

From a linear to a circular economy

Linear economy



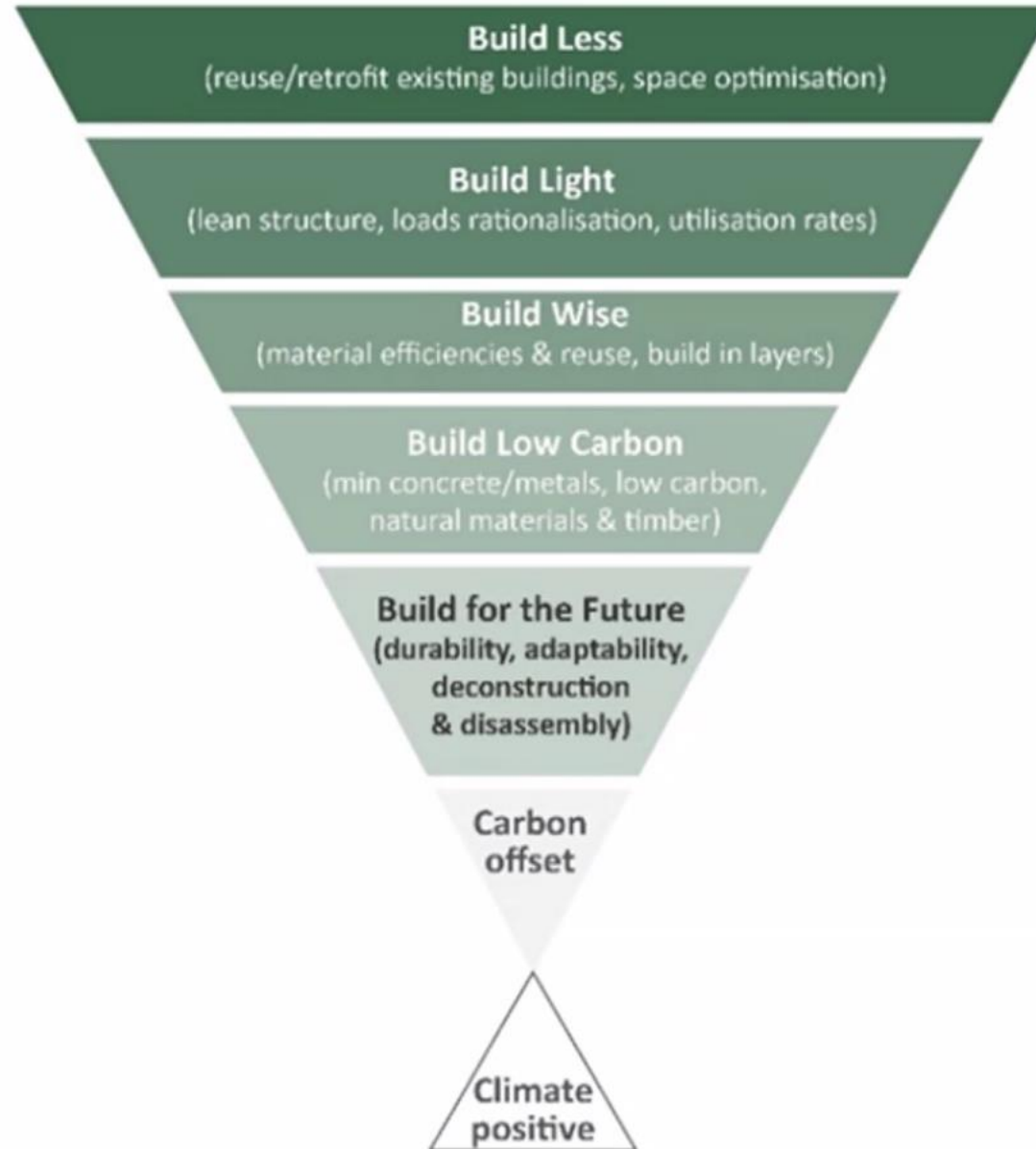
Reuse economy



Circular economy



REDUCING EMBODIED CARBON



Cradle to Grave	Describes all the processes which a product or component goes through from raw material extraction to obsolescence and final disposal. It assumes no EoL residual value.
Cradle to Gate	Describes the impacts associated with products, materials or processes up to the point at which they are packaged and ready for delivery to site.
Cradle to Site	Describes the impacts associated with suppliers (raw materials), transportation to manufacturing centre, manufacturing, packaging, and transportation to site. In the case of construction impacts, this would also include any processing required on site to make use of the product or component.
Cradle to Cradle	Similar to Cradle to Grave, but assumes that an obsolete component has a residual value at the end of its <i>first</i> life. It assumes that construction waste can be recycled and used to provide raw materials for re-manufacture of the same product, or new and different products.
Embodied Energy (EE)	A Cradle to Gate or Cradle to Site analysis based on energy inputs only. i.e. those energy inputs relating to raw material extraction, transportation, processing, manufacturing, and packaging.
Embodied Carbon (EC)	Converts this embodied energy from MJ to tonnes of CO ₂ . Frequently embodied CO ₂ is given as CO ₂ e
Equivalent Carbon Dioxide (CO ₂ e)	A way of describing how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of carbon dioxide (CO ₂). Put simply, if CO ₂ has a Global Warming Potential (GWP) of 1, then Methane has a GWP of 25, and Nitrous Oxide a GWP of 298.