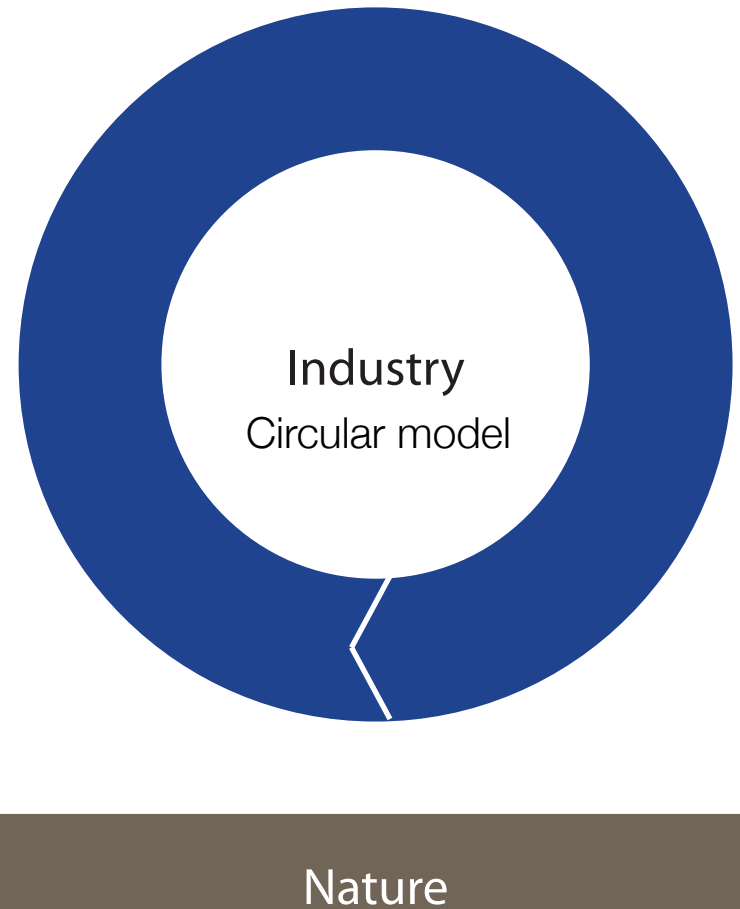
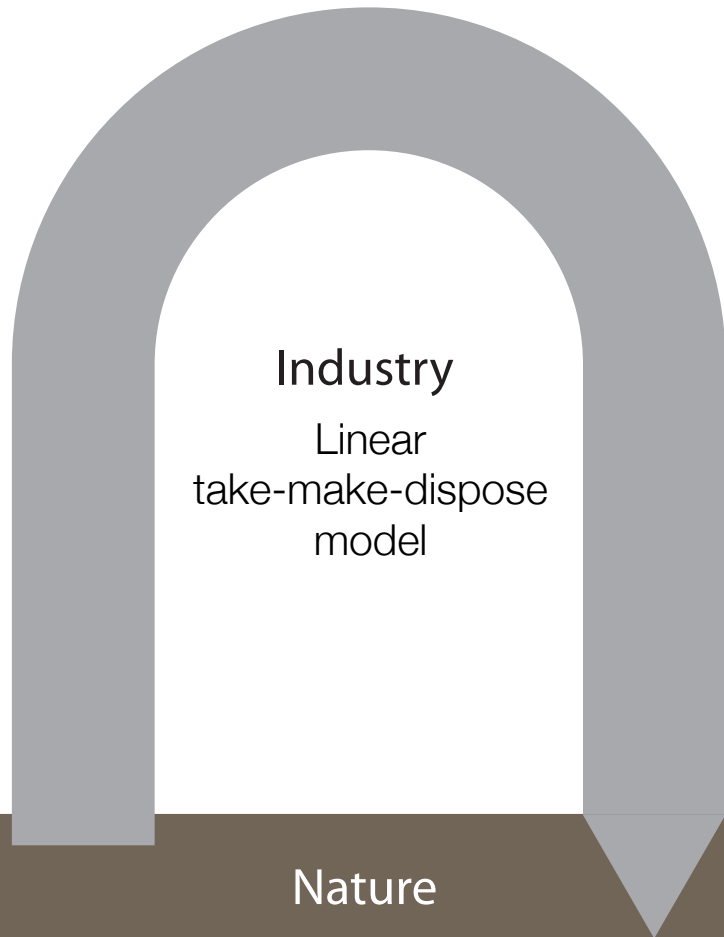




system perspectives on the
circular economy

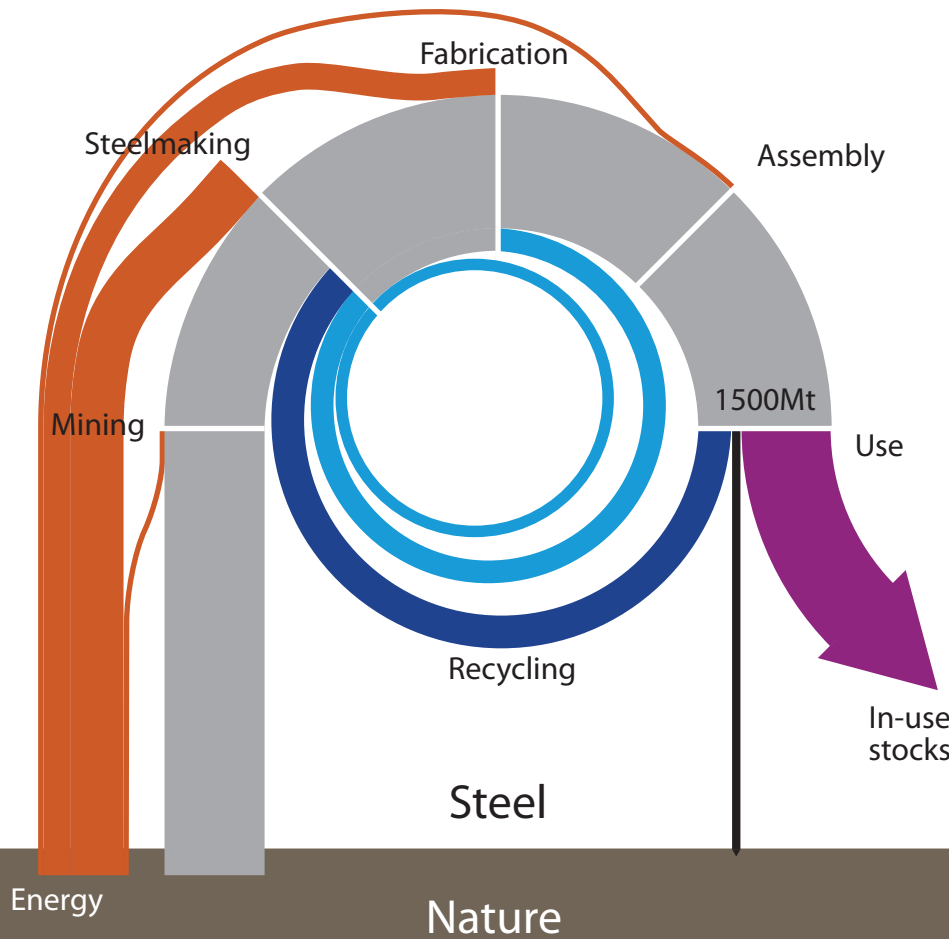
Jonathan Cullen
jmc99@cam.ac.uk

an elegant solution ...

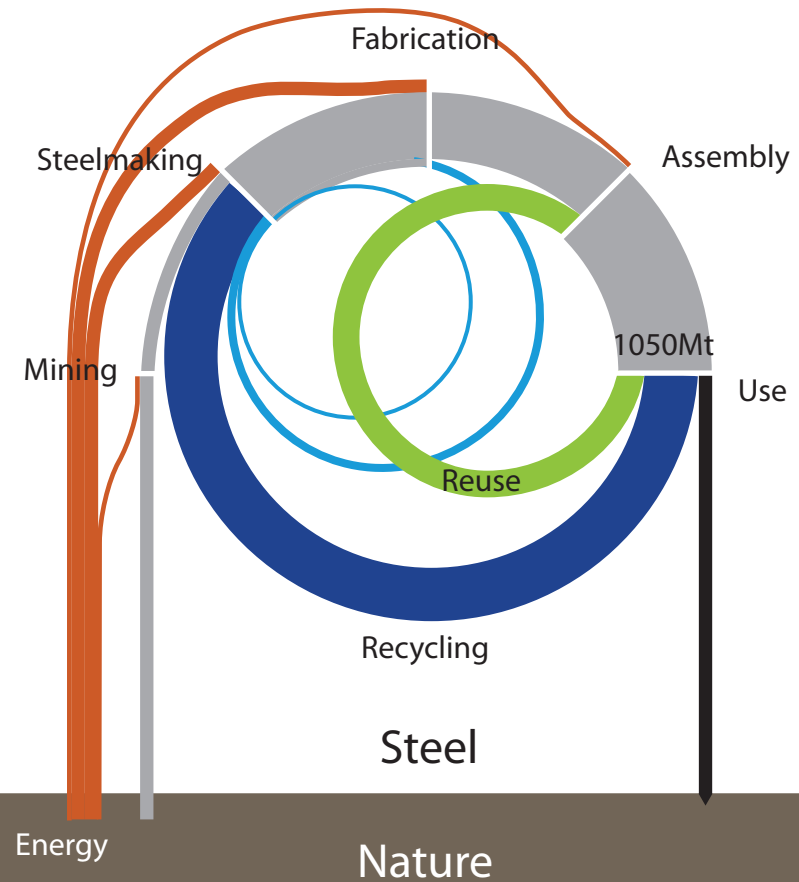


that in reality is more complicated ...

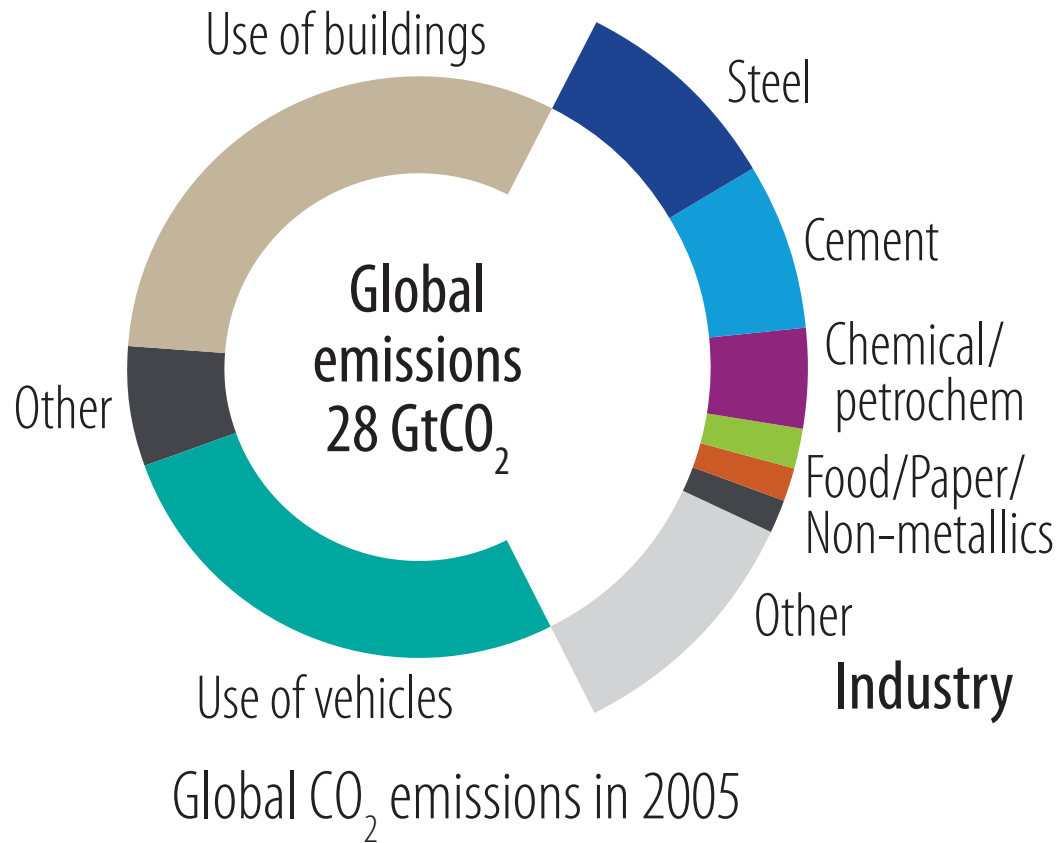
Today's map



Possible future



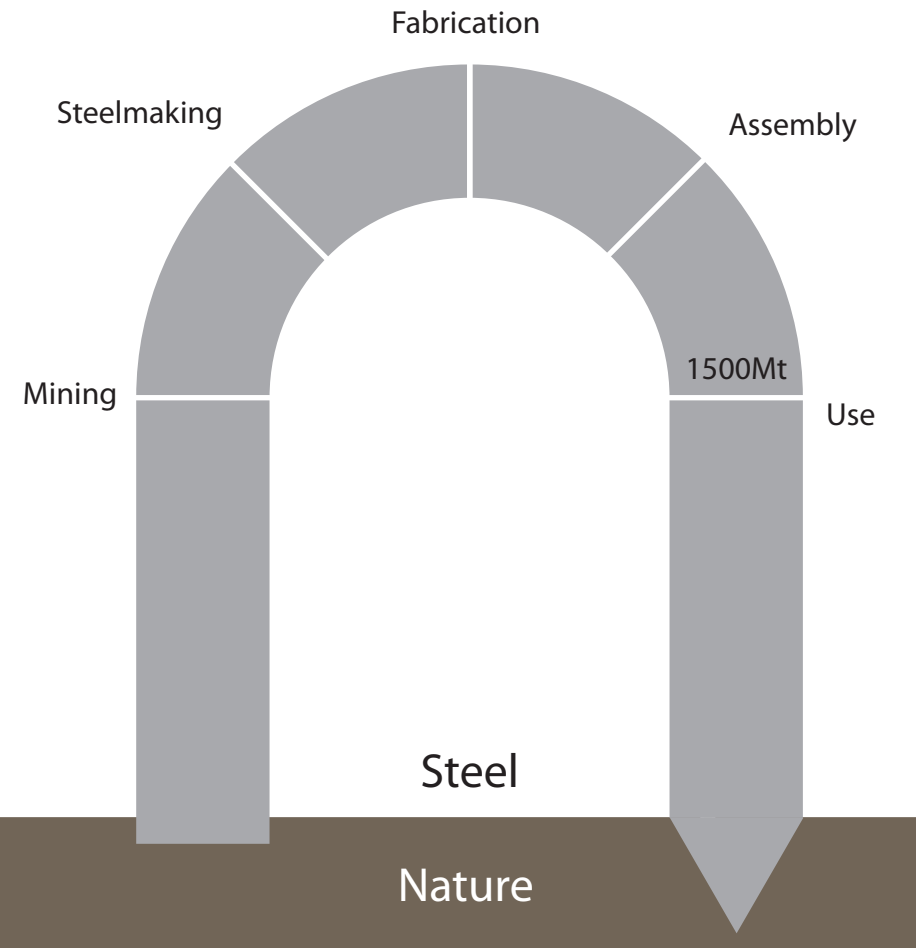
needs a materials view ...



6 key sectors account for 70% of industry emissions

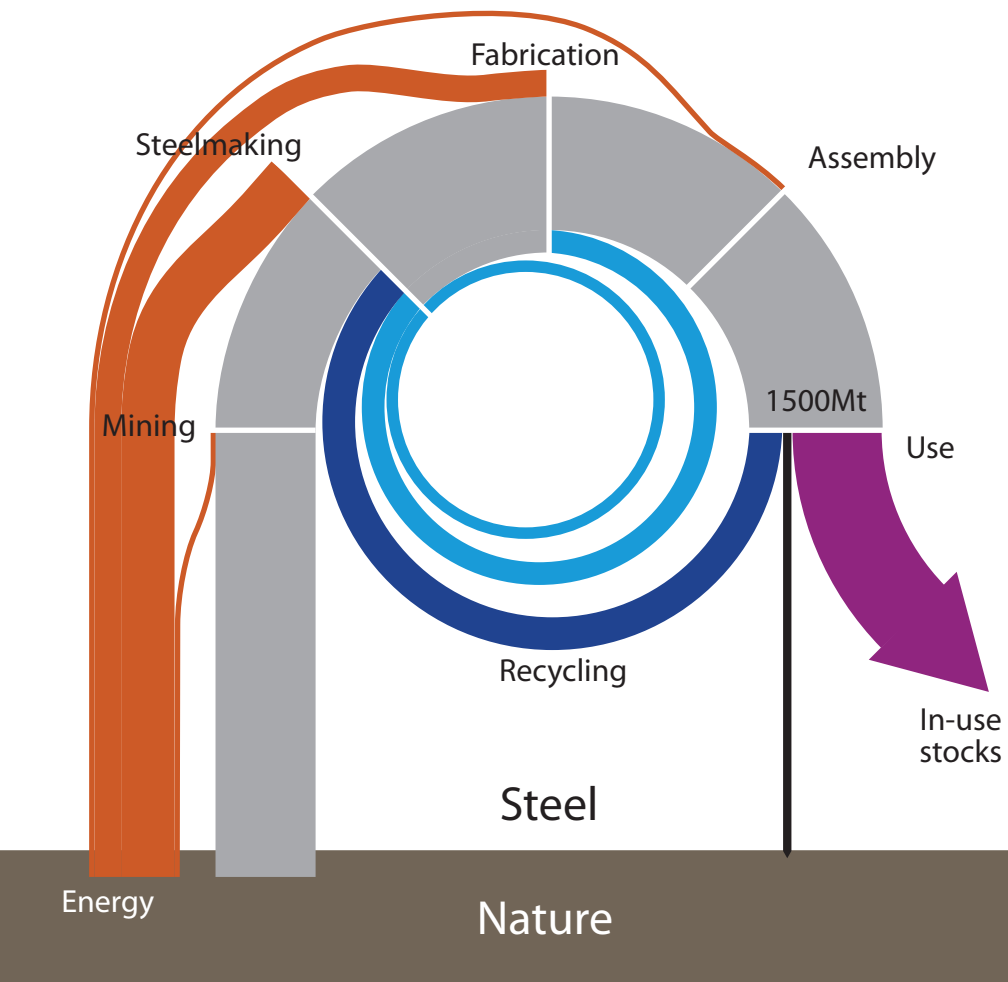
materials are the key link running through both the linear and circular models

why so difficult ...



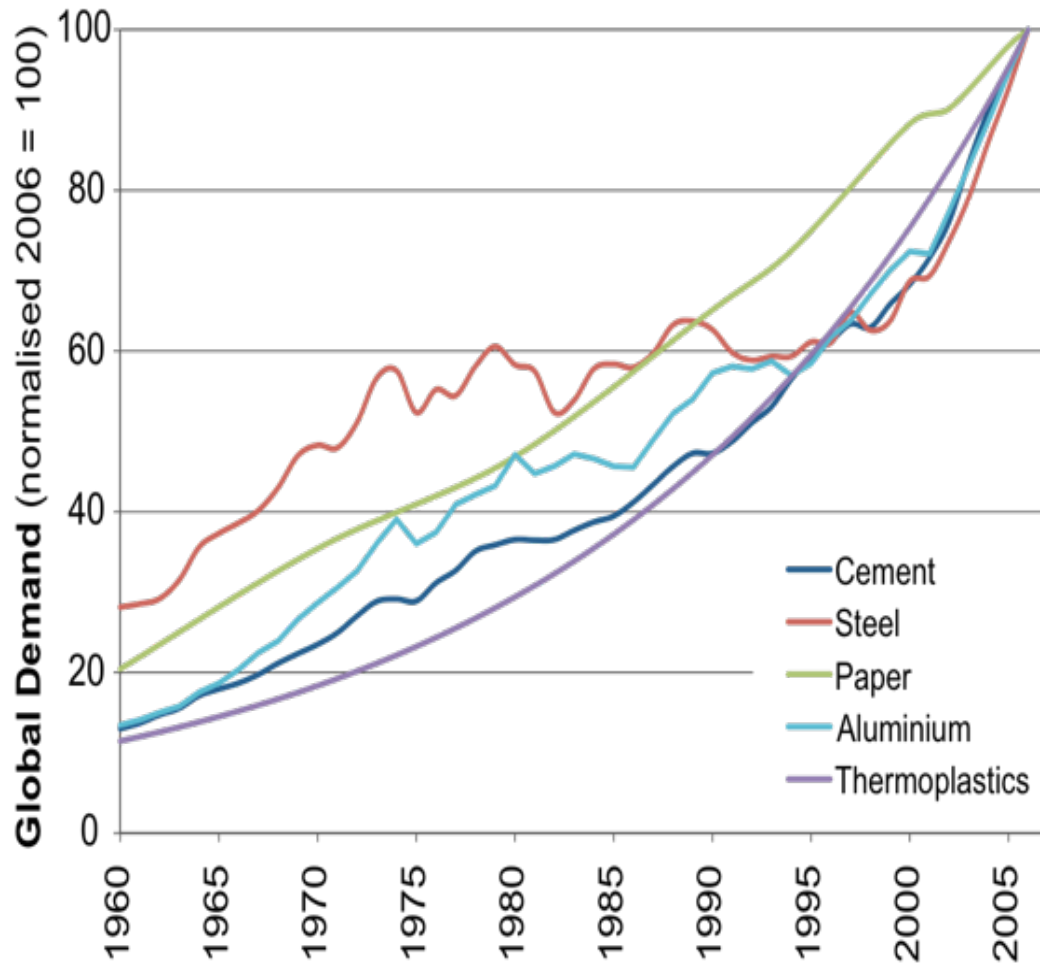
today's linear industrial system is not that simple

why so difficult ...



4 challenges to contend with:
in-use stocks keep growing
materials are down-cycled
energy is not renewable
even steel reuse is difficult

in-use stocks keep growing ...



circular resource loops
require stable stocks of
materials in use

materials are down-cycled

Most steel is down-cycled into lower-quality reinforcing bar. Copper and tin in the steel is an issue for using scrap to make sheet steel.

Most aluminium is down-cycled (or cascaded) from pure aluminium, to wrought aluminium (sheet metal), to cast aluminium (engine blocks and gearboxes).

Wood fibres in paper survives only 7 recycling stages. High-quality paper is down-cycled to low-quality board.

Mixed post-consumer plastic waste is difficult to recycle, and is either down-cycled into bulk plastic products, incinerated or exported to other countries.

Recycling concrete as aggregate in new concrete requires more cement than for virgin concrete.

Glass bottles mostly end up as filler material in road construction ... an alternative tax-free landfill site.

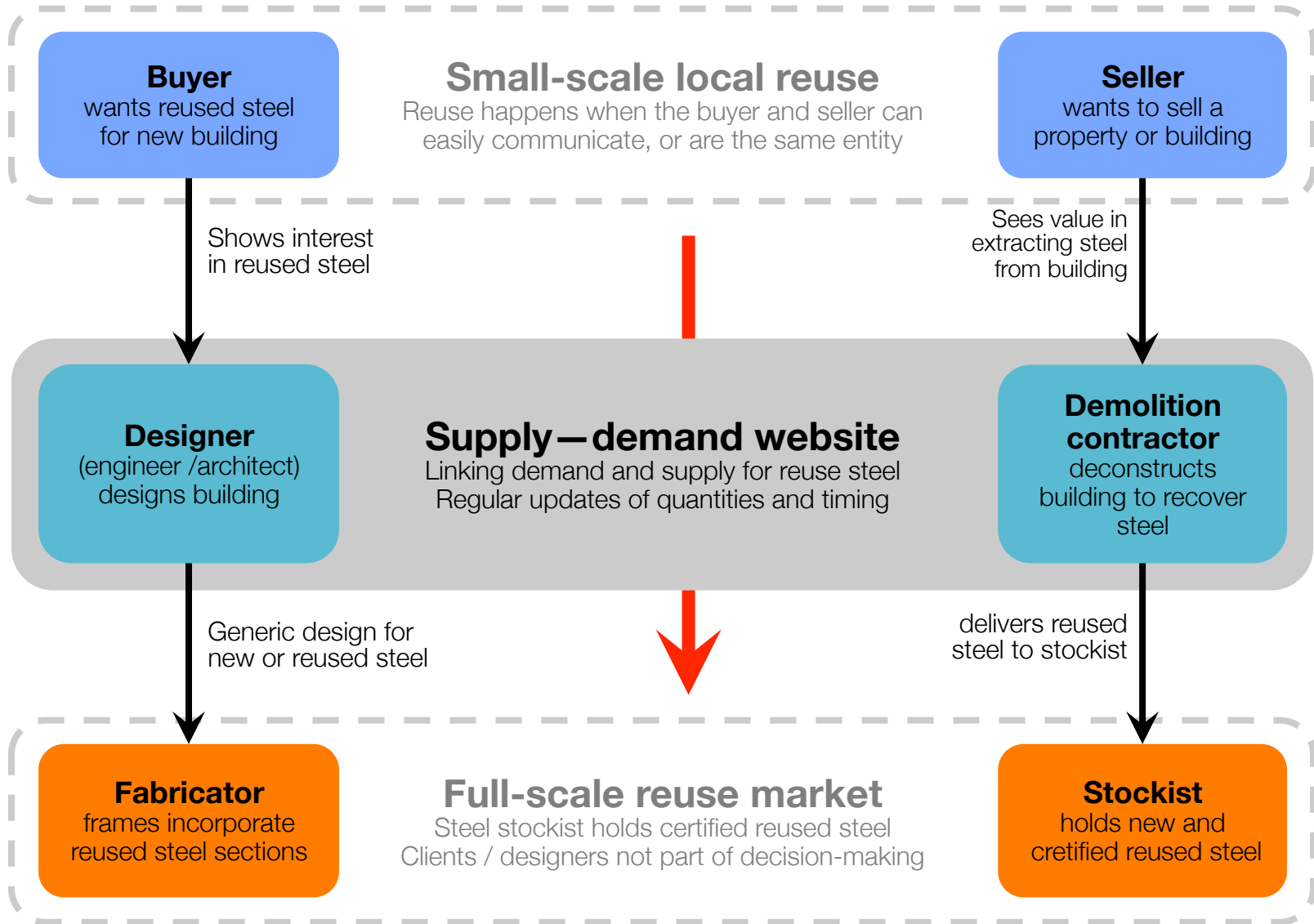
material quality needs
to be maintained in
circular resource loops

energy is not renewable ...



circular resource loops
require renewable
energy to make sense

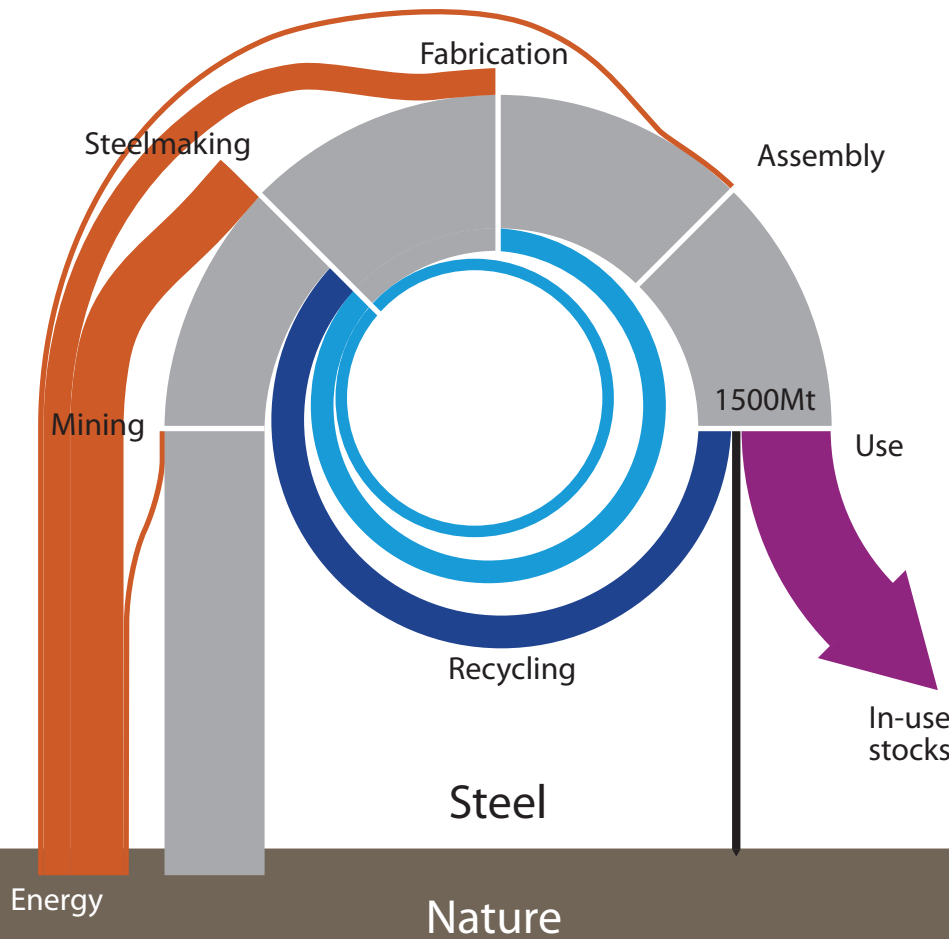
even reuse of steel beams is difficult ...



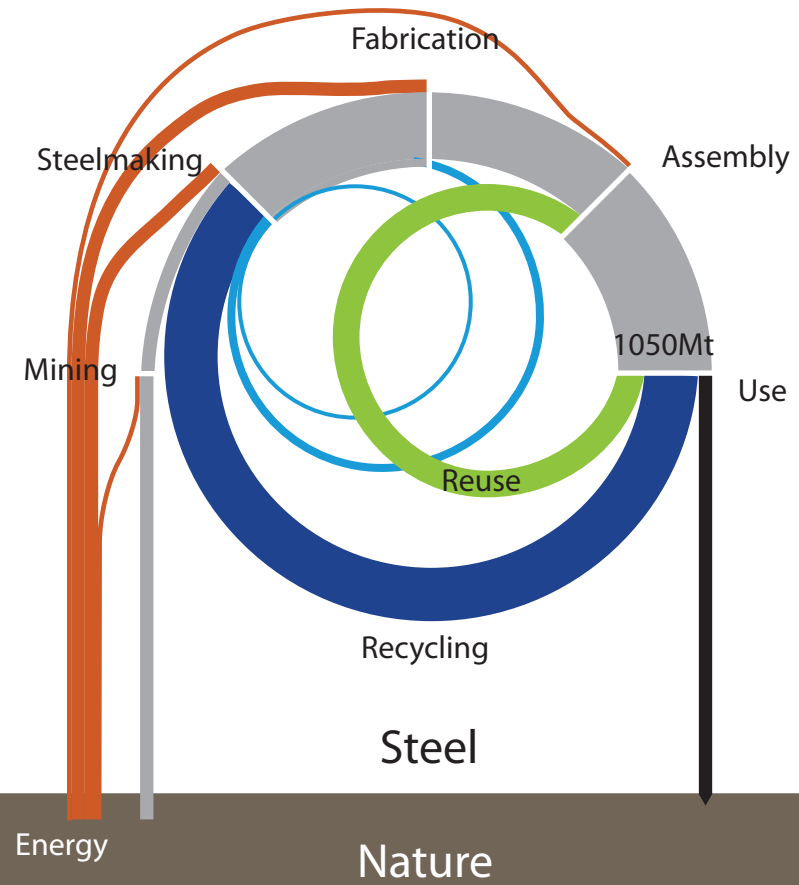
supply chains need to be completely reconfigured

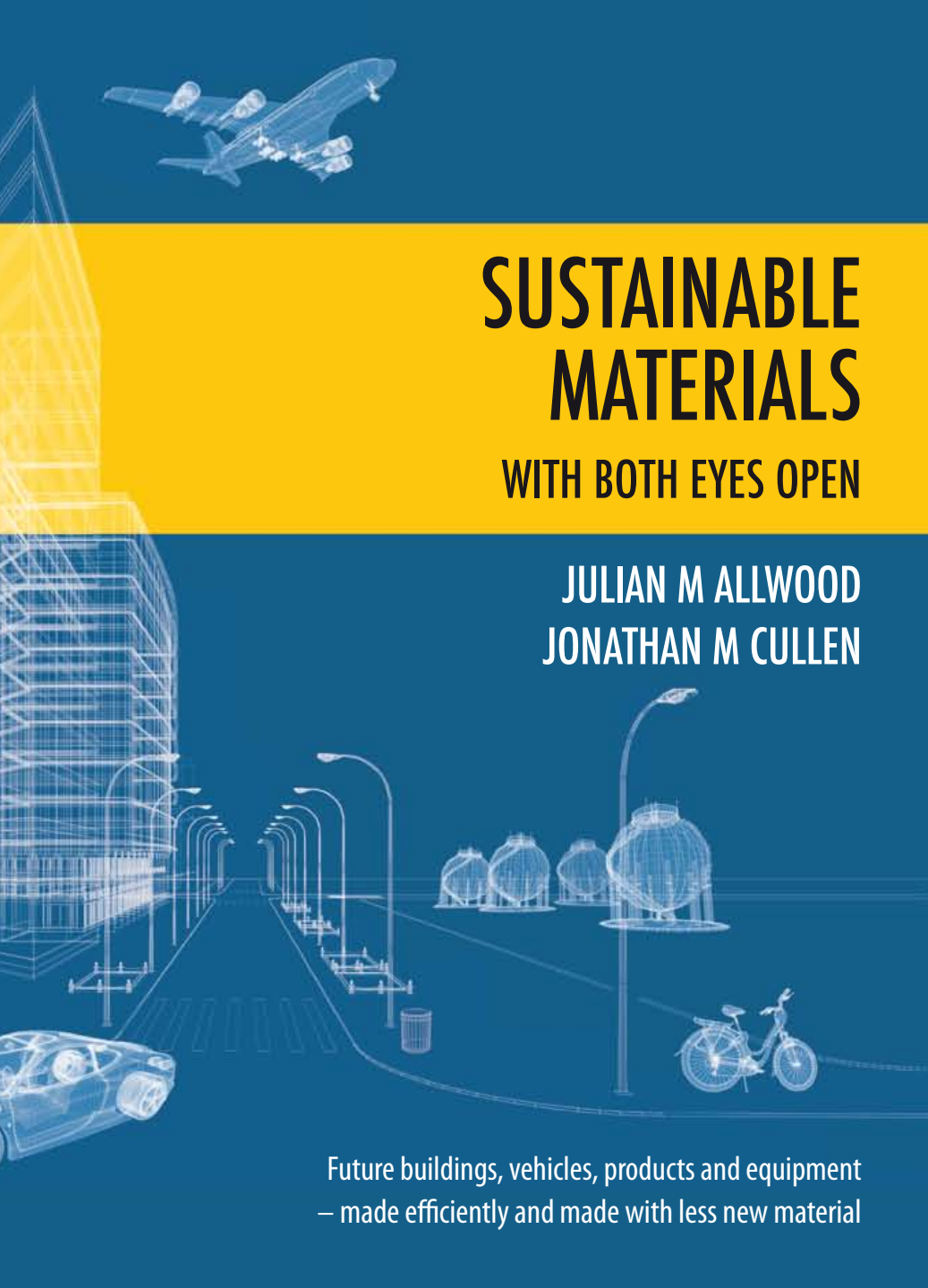
there's still much to do ...

Today's map



Possible future





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system perspectives on the
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Jonathan Cullen
jmc99@cam.ac.uk