



The  
University  
Of  
Sheffield.

# The importance of understanding the material metabolism of the built environment

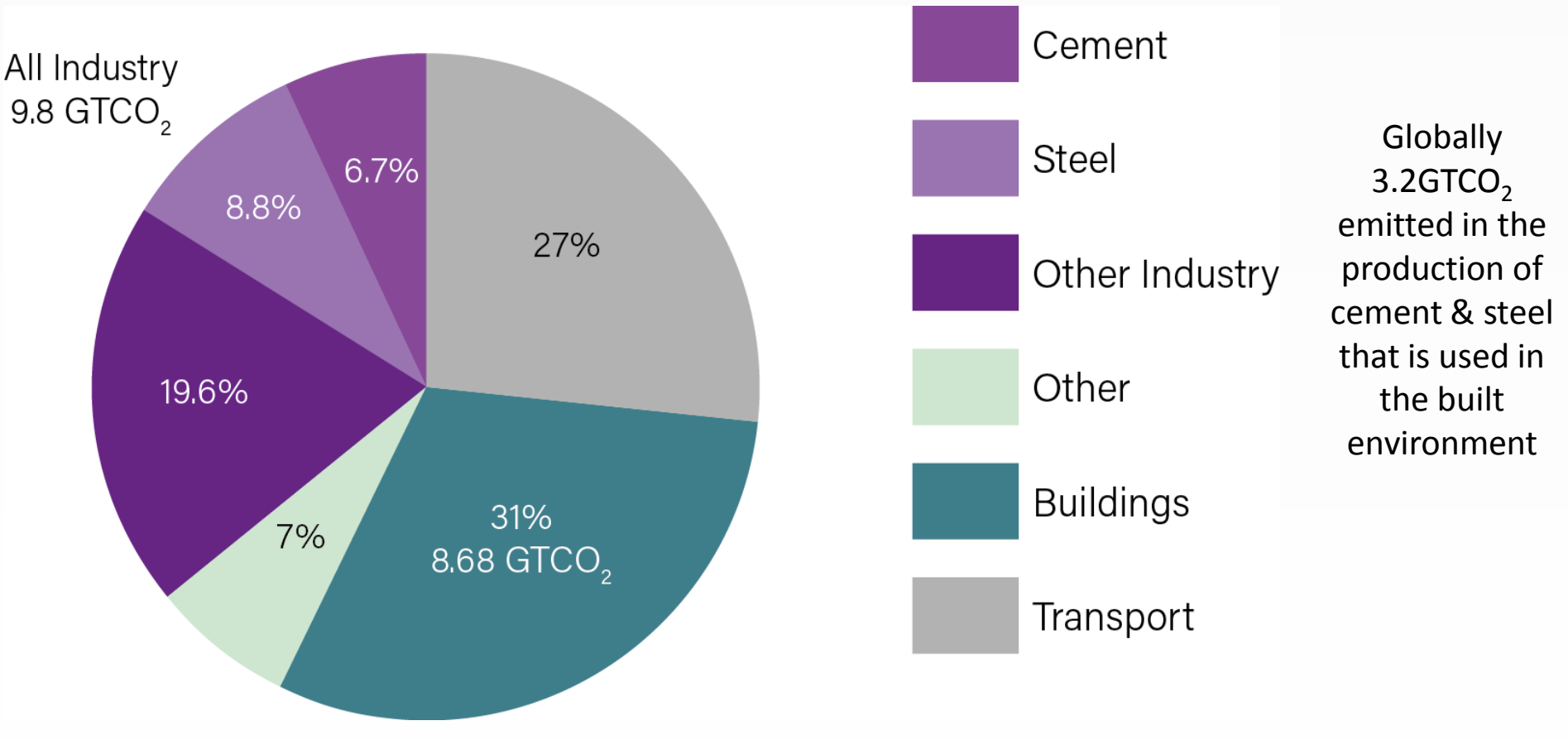
Dr Danielle Densley Tingley

# The Impact & Role of Cities

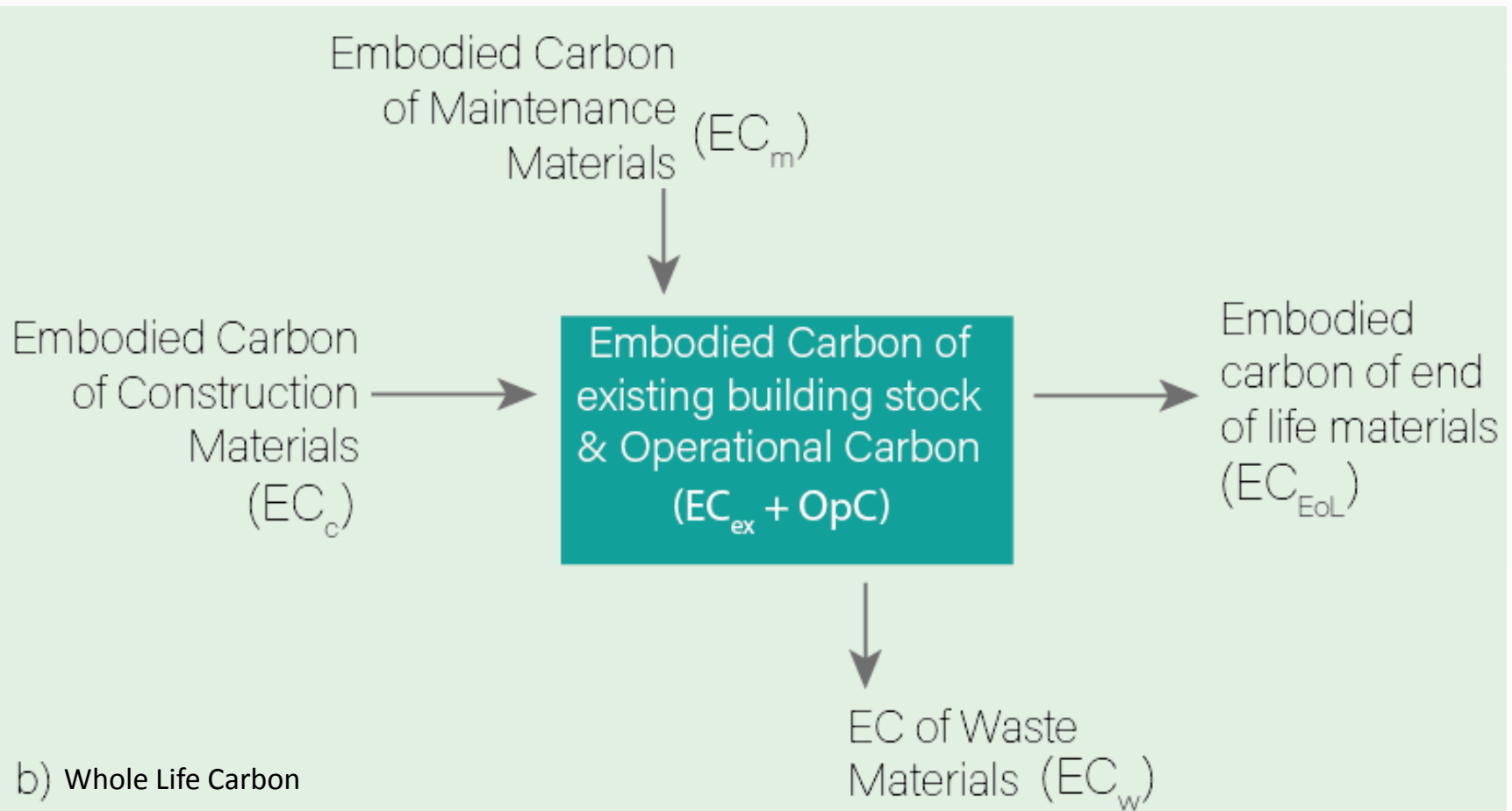
- Cities account for 75% of global GHG emissions
- Urbanisation is rapidly increasing
- Can provide a leverage point to create change



# The global impact of materials

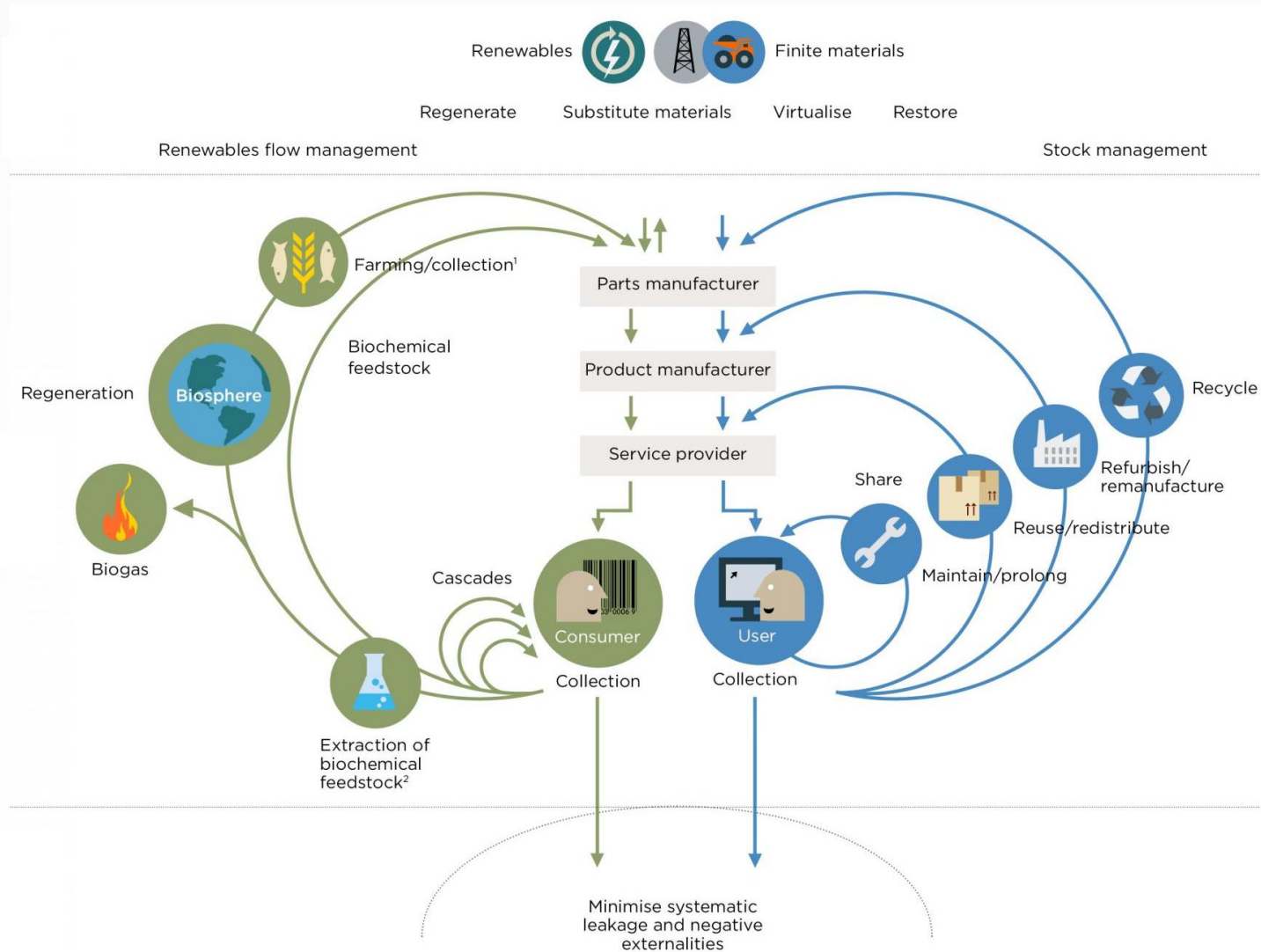


# Material use a city system: the built environment

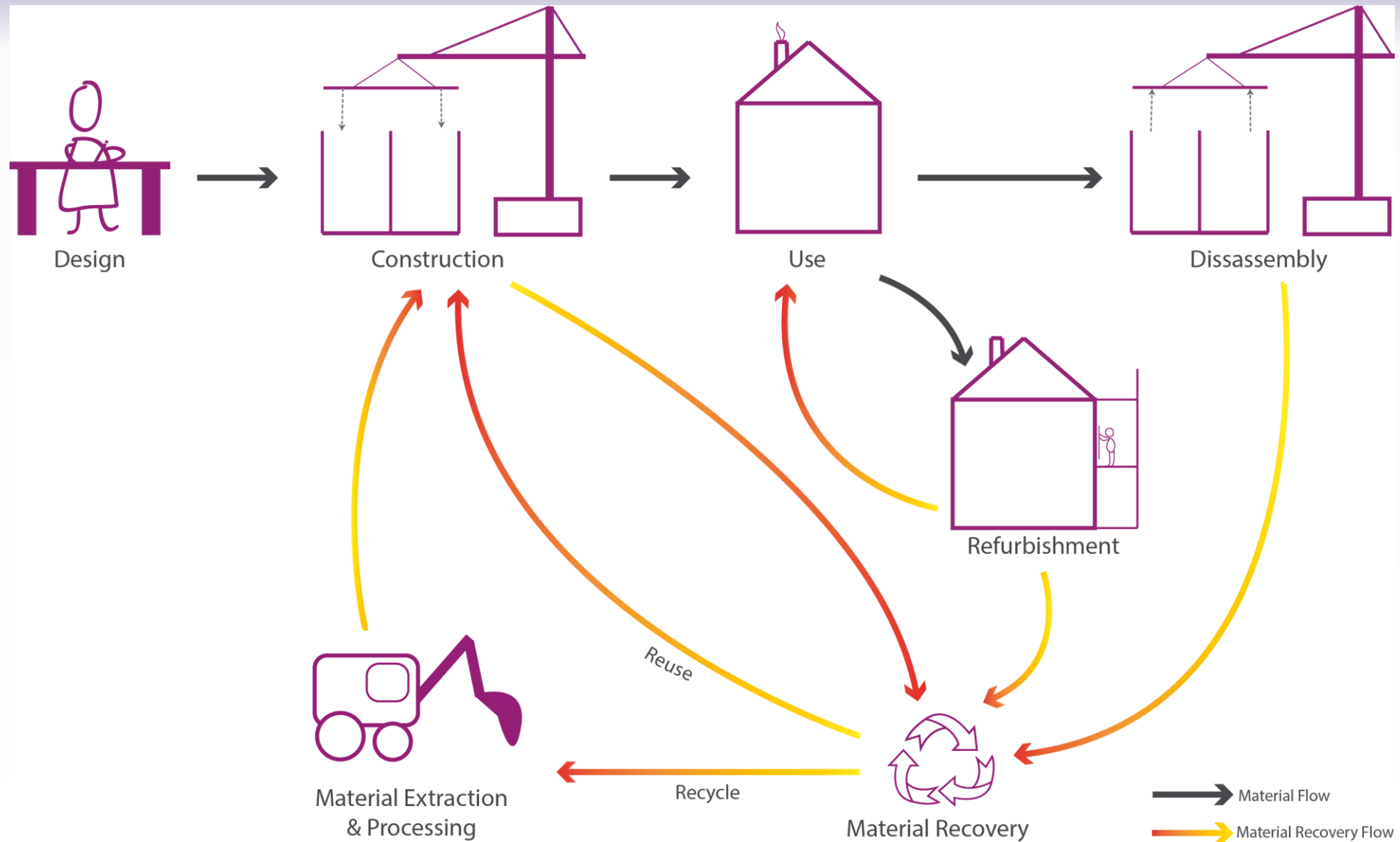


# The Circular Economy

- Moving towards closed loop systems
- Maintaining asset value



# What could this look like in construction?



# Material Flow Analysis

- Methods to estimate material stocks & flows
- Bottom-up accounting: inventory of materials, generally at a fixed point in time
- Top-down accounting: using time series, statistical data to estimate material inputs, stocks & outputs
- Demand modelling: predicting future demand for materials
- Remote Sensing: using satellite data to estimate stocks

# Sheffield, an example system

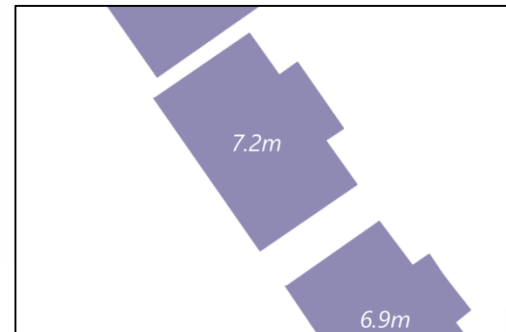
- What is Sheffield made of?
  - At a high resolution level of detail....
- New build rate, construction types & material demand
- Where are unused buildings?
  - How could these be repurposed?
- Demolish rate & construction types
  - Reuse potential





# What is Sheffield made of?

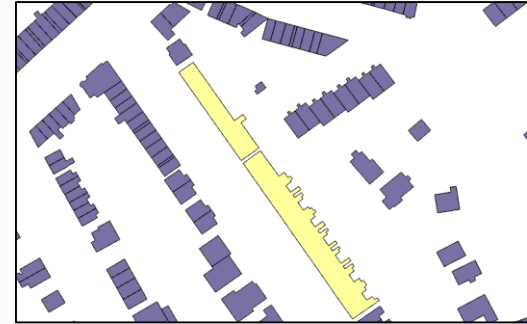
- Building massing: combining LiDAR & Digimap
- Next step is to material tag different buildings
  - Can be done manually, can this be automated?
- Add building age & construction technique
- Generate a detailed picture of the building & material assets in the city



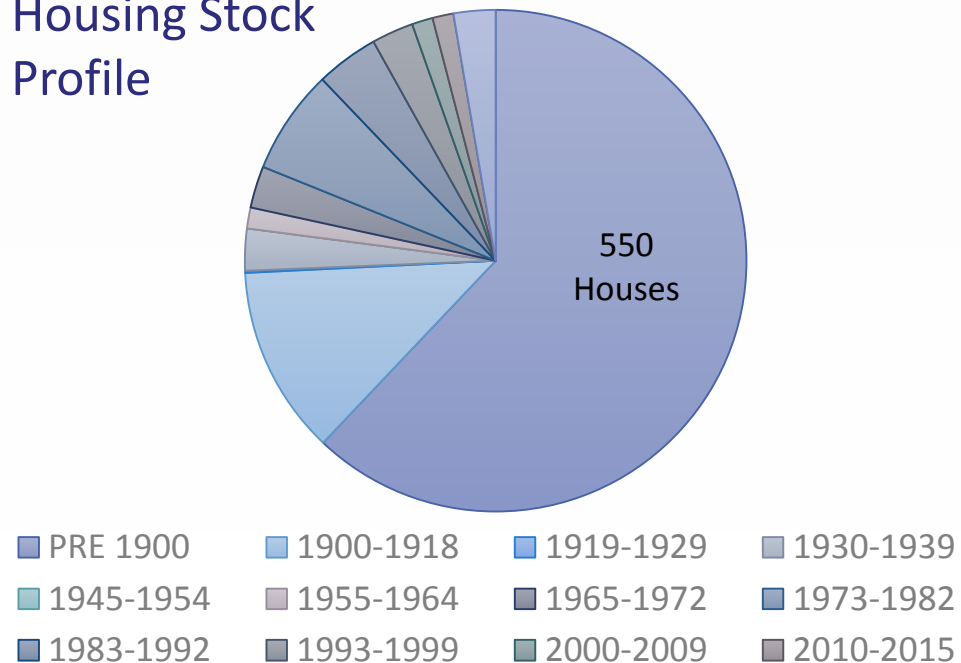
# Neighbourhood Study: Walkley

- With digimap & LiDAR can work out surface areas:
  - Insulation area required for retrofit
  - The number of bricks available for future reuse (when combining with age data)

An example study of a street revealed 3680m<sup>2</sup> of walls that could require insulation & an asset of approx. 475,000 bricks



Housing Stock Profile



# Cataloguing Neighbourhood Assets

- 475,000 bricks in a street
- 75% of area pre-1925 construction, 3% 1925-1955, 22% Post 1955
- Can estimate that 364,800 bricks could be salvaged in the future
- Price of a new brick approx. 75p
- Asset value: £273,600
- Embodied Carbon stock: 200,640 kgCO<sub>2</sub>

<b>Age</b>	<b>Mortar types in Europe</b>	<b>Assumed reusability</b>
Pre-1925	Likely to be lime mortar	100%
1925-1955	Could be lime, cement, or a mixture	60%
Post-1955	Likely to be cement	0%

Adapted from Nordby et al. (2009)

# Next Steps

Automating the material recognition process

## Sheffield Urban Flows Observatory:

A key aim: to understand Sheffield's Material Metabolism

