structural steel reuse

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Steel and the circular economy
The Building Centre, London

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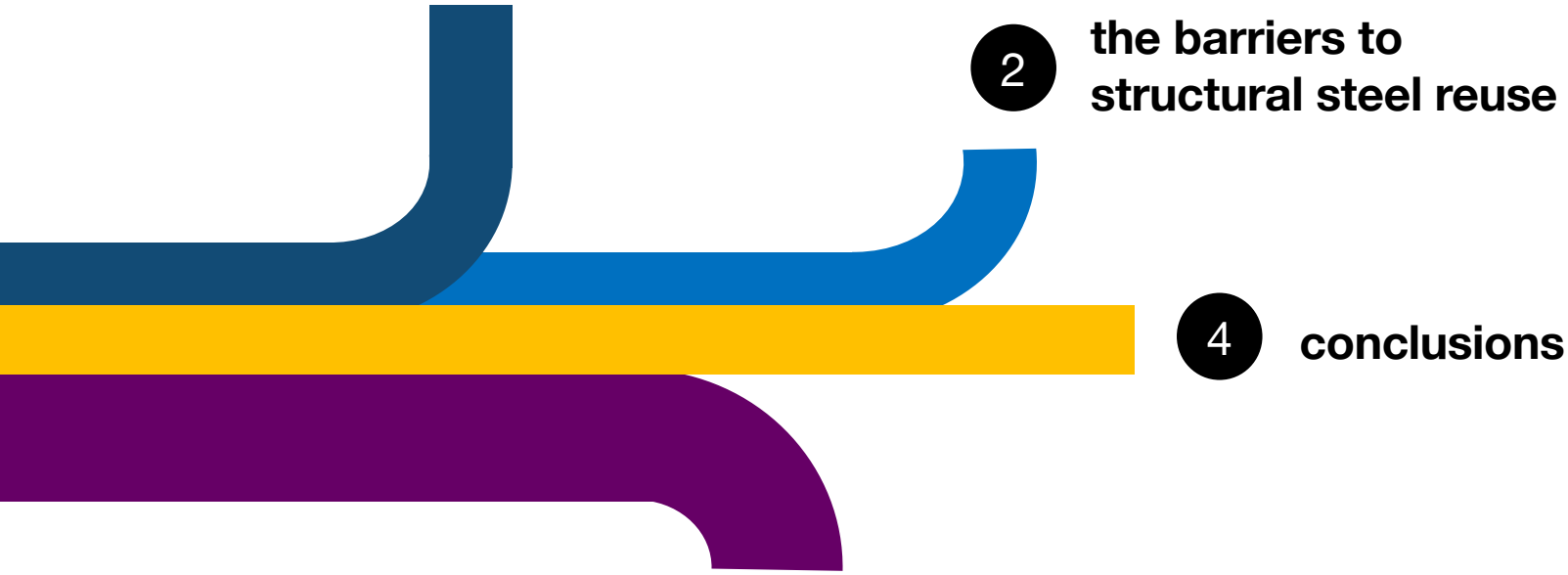
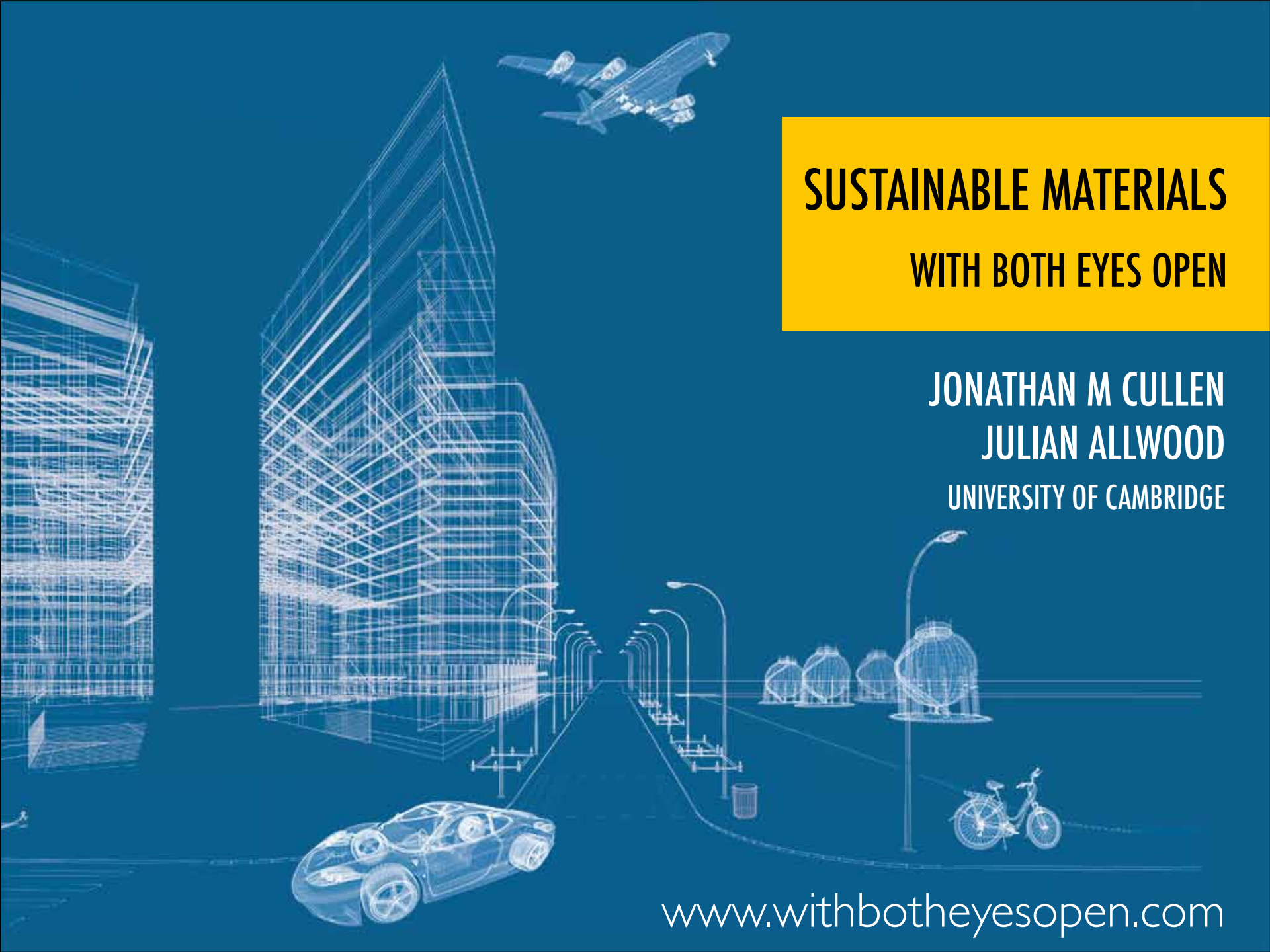


the case for structural steel reuse



SUSTAINABLE MATERIALS

WITH BOTH EYES OPEN

JONATHAN M CULLEN
JULIAN ALLWOOD
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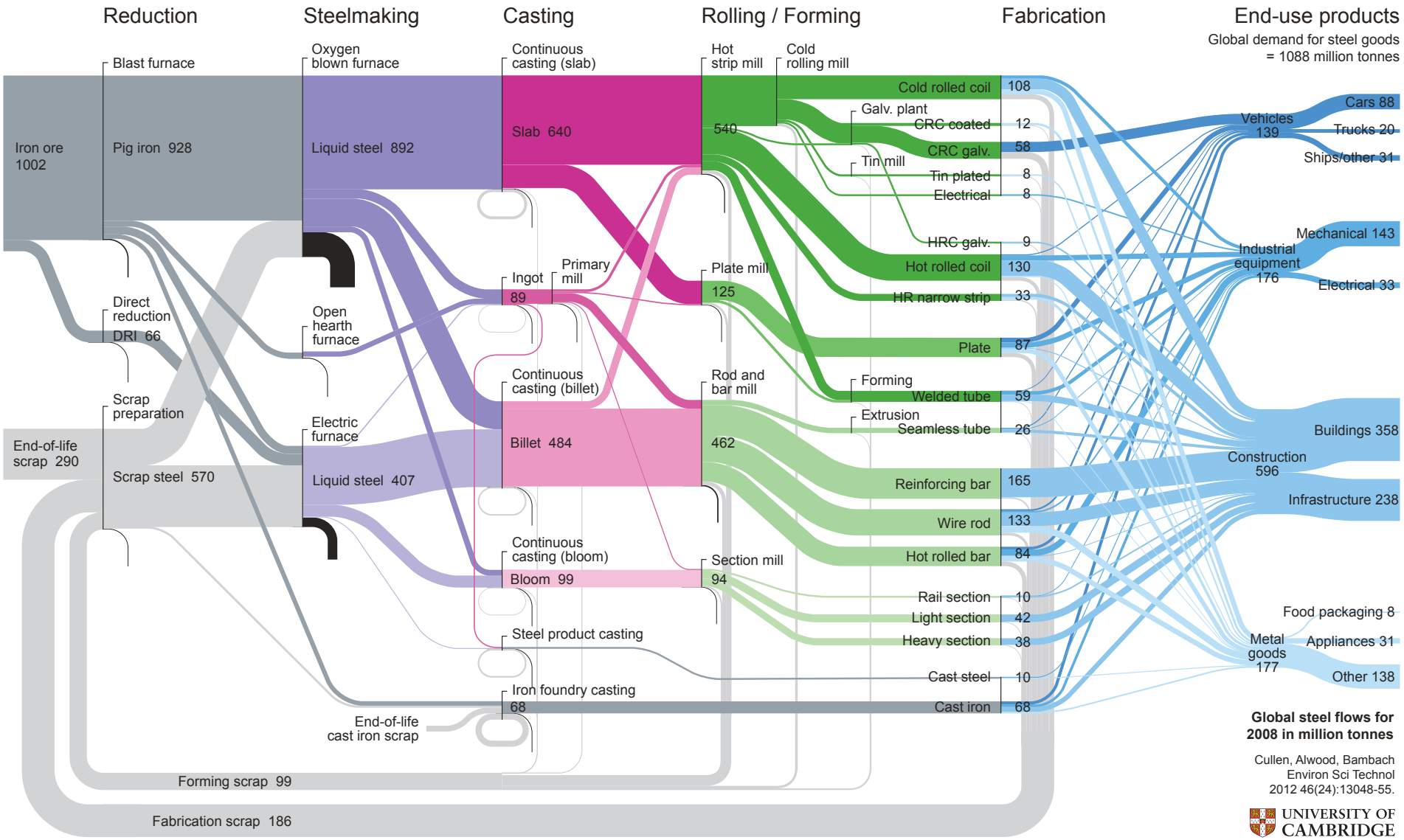
www.withbotheyesopen.com

global flows of steel



Global steel flows for 2008 in million tonnes

Cullen, Alwood, Bambach
Environ Sci Technol
2012 46(24):13048-55.

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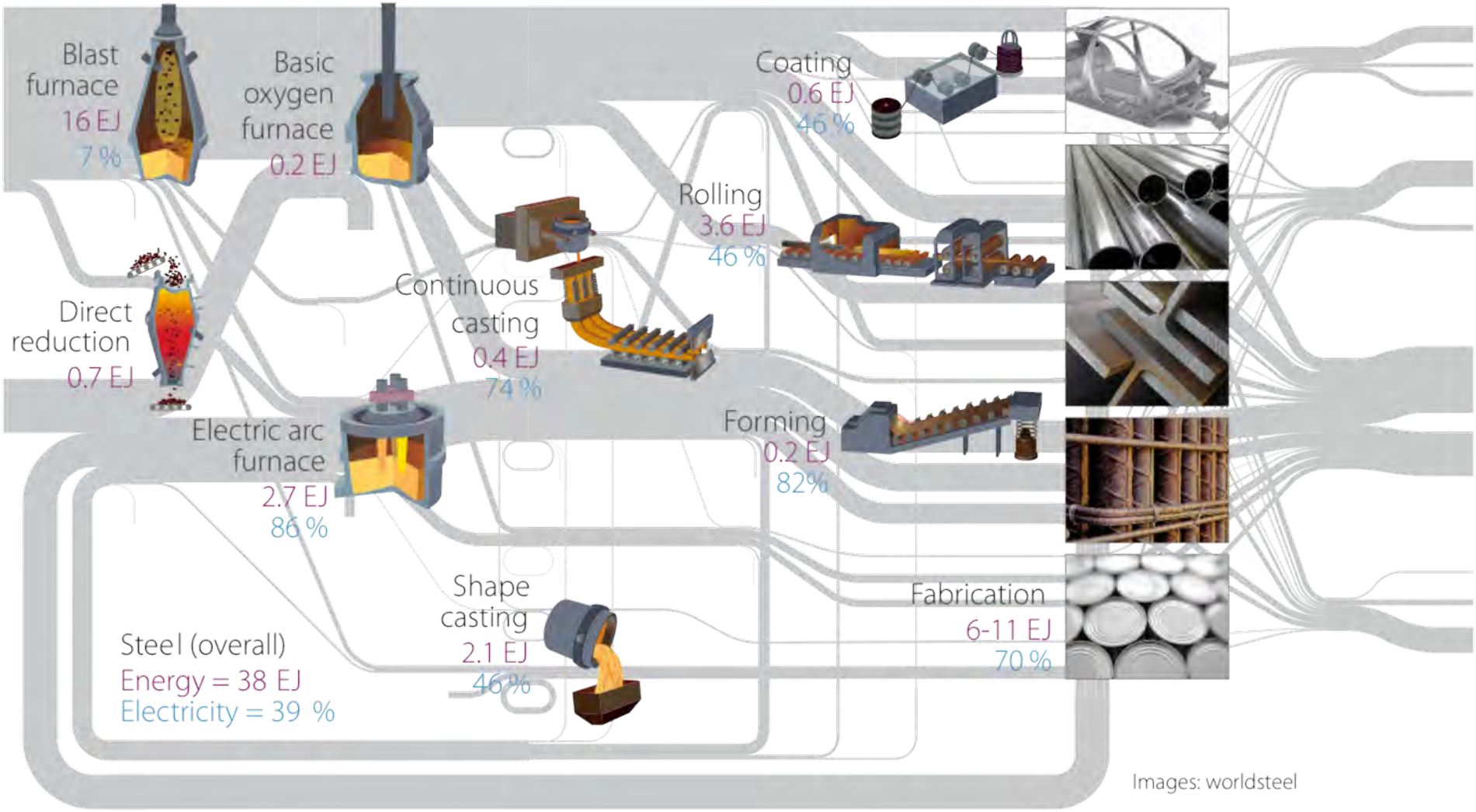
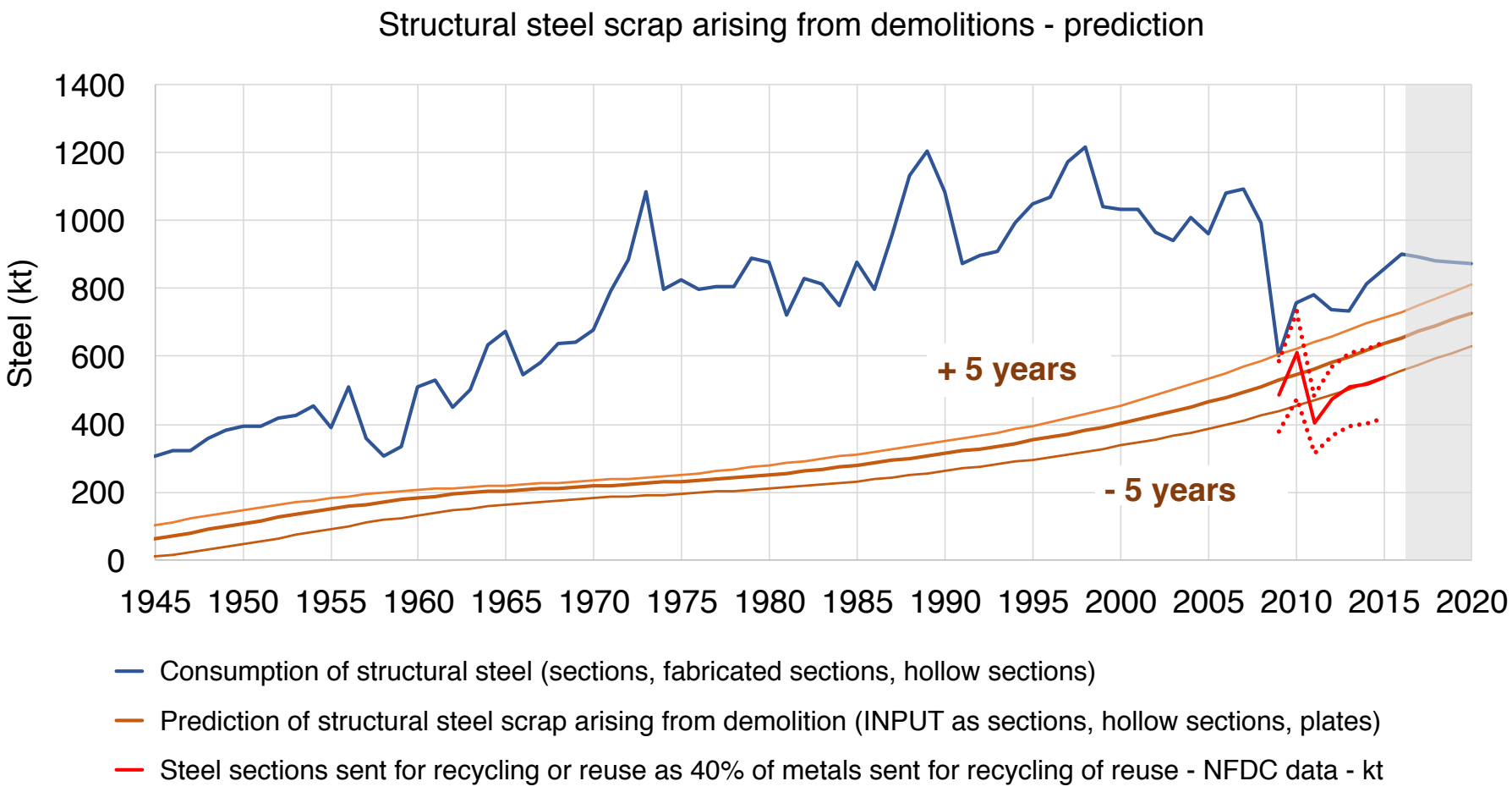
… and energy inputs



the economic margin

availability of used structural steel



successful reuse of structural steel

740 Rue Bel-Air
Montreal, Quebec

BedZED
London

successful reuse of structural steel

Carrwood Park,
Doncaster

Blue Steel
Building, Leeds

successful reuse of structural steel

Kings Science Academy, Bradford

University Technical College, Leeds

successful reuse of structural steel

9 Cambridge Ave
(Segro), Slough

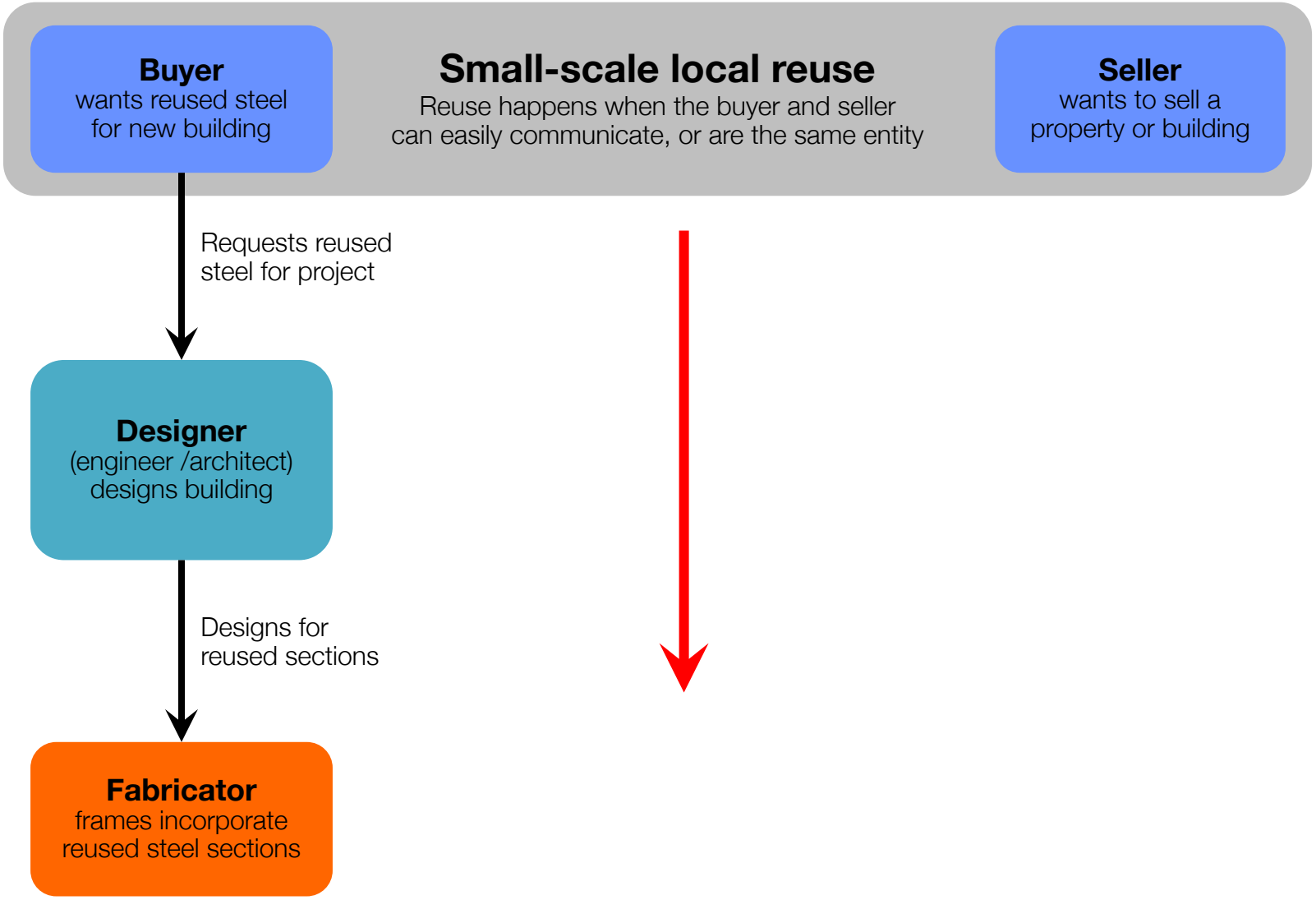
Honda Warehouse,
Swindon

why is reuse not happening at scale?

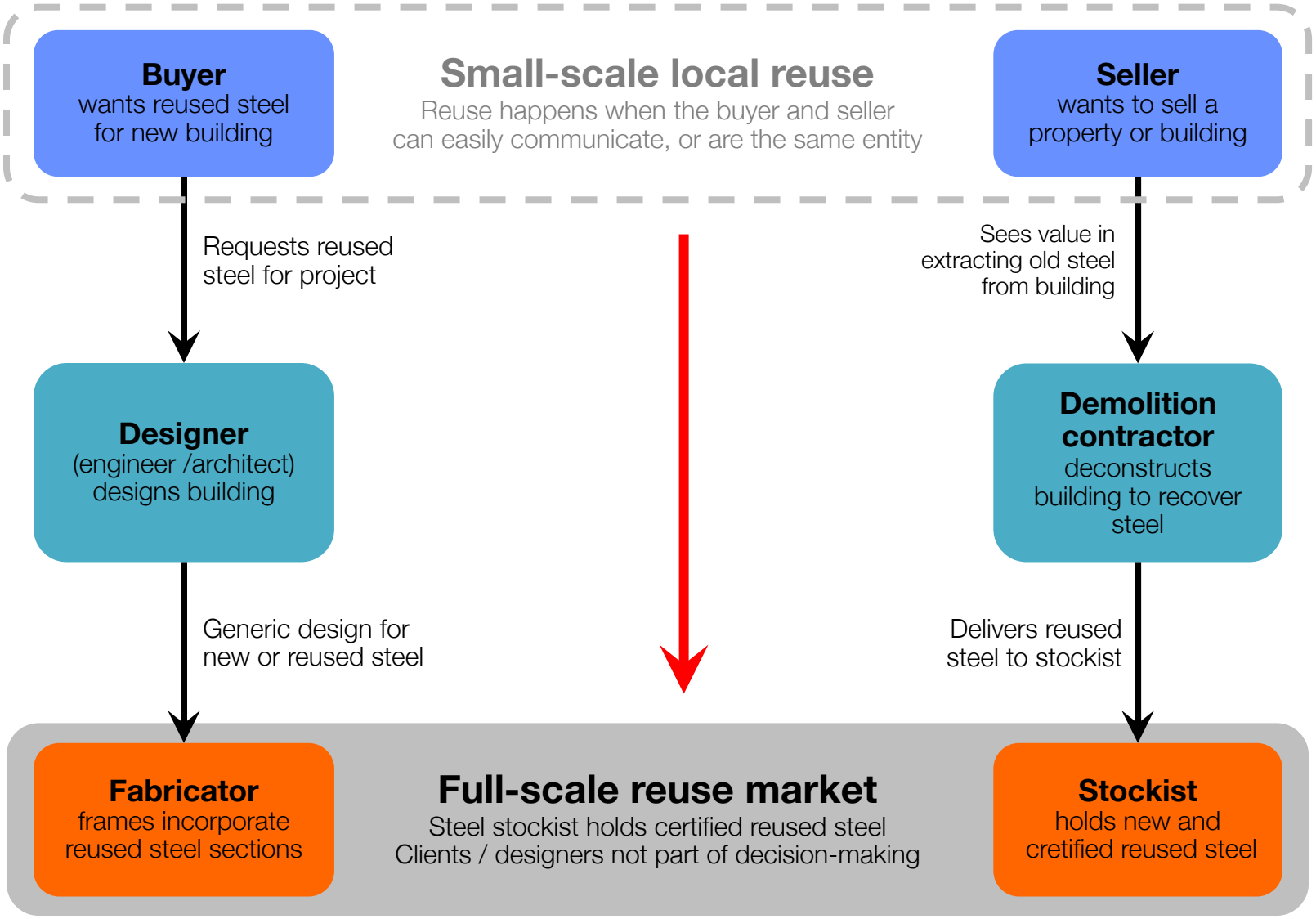
Year	Author	Reuse	Recycle	Landfill	Note
2001	Steel Construction Institute	12%	93%	5%	Heavy sections
2006	Gorgolewski *et al.*	10%	90%	nil	Sections, Canada
2012	EUROFER	7%	96%	2%	Heavy sections

Reuse rates in the UK for structural steel are low and are falling

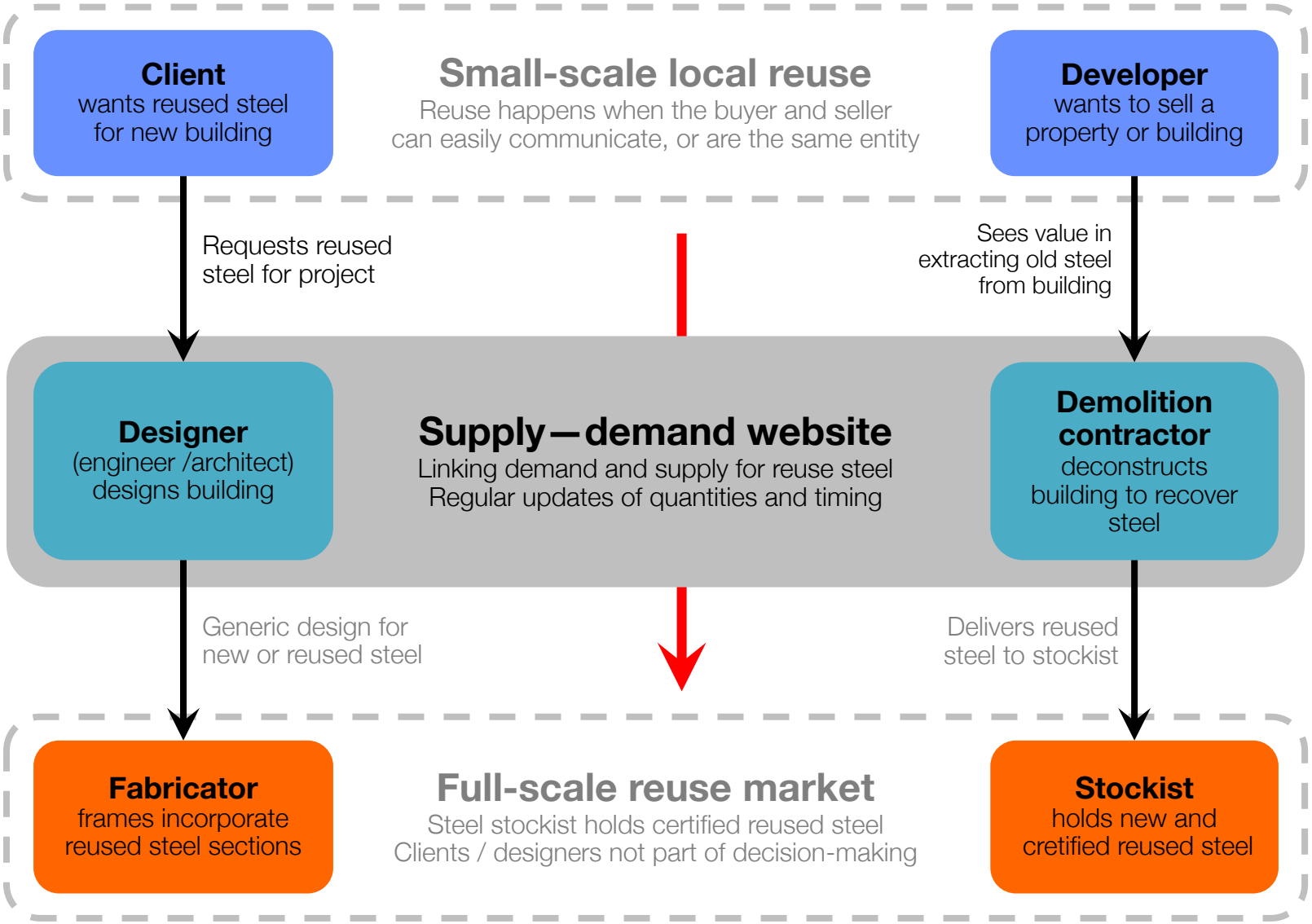
hypothesis : current practice



hypothesis : where we would like to be

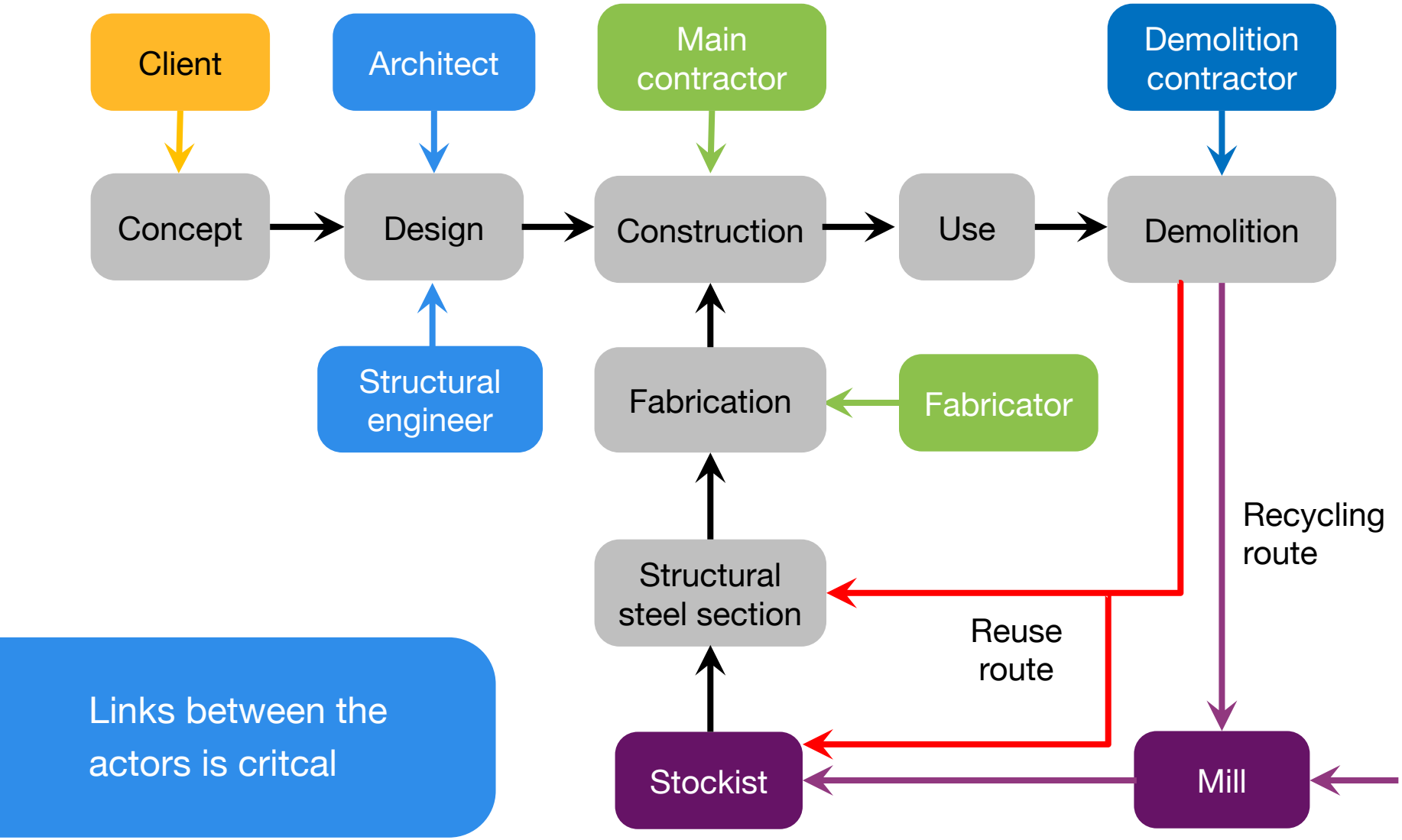


hypothesis : a step along the way



the barriers to structural steel reuse

Building lifecycle and supply chain actors

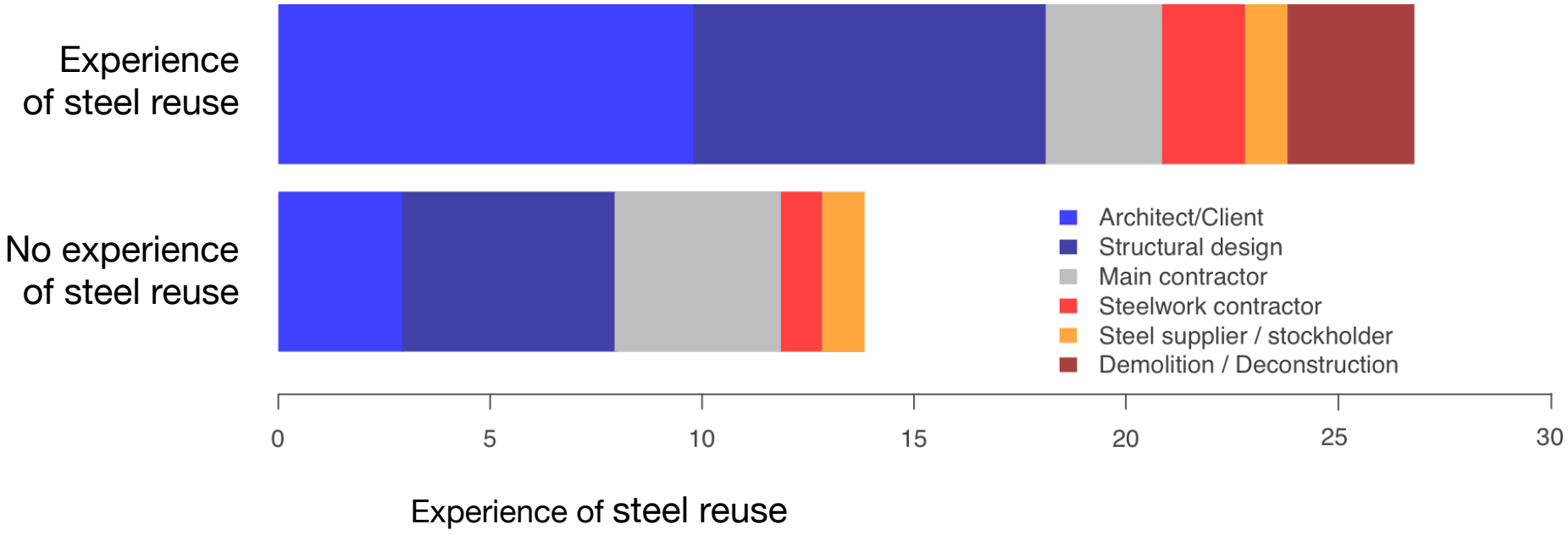


barriers identified

- **Profit opportunity/cost**
  additional cost and risk of reusing steel
- **Programme**
  disruptions causing delays to the project timeline
- **Quality/certification/traceability**
  certifying the properties of structural steel
- **Availability/Dimensions**
  difficulties sourcing the correct section sizes
- **Old/New perception**
  concerns that reused steel is inferior
- **Trust/Lack of communication**
  issues of trust and liability
- **Uncommon practice**
  reluctance to change current practices
- **Design for deconstruction**
  challenges in recovering sections from buildings

Barriers to structural steel reuse identified in the literature

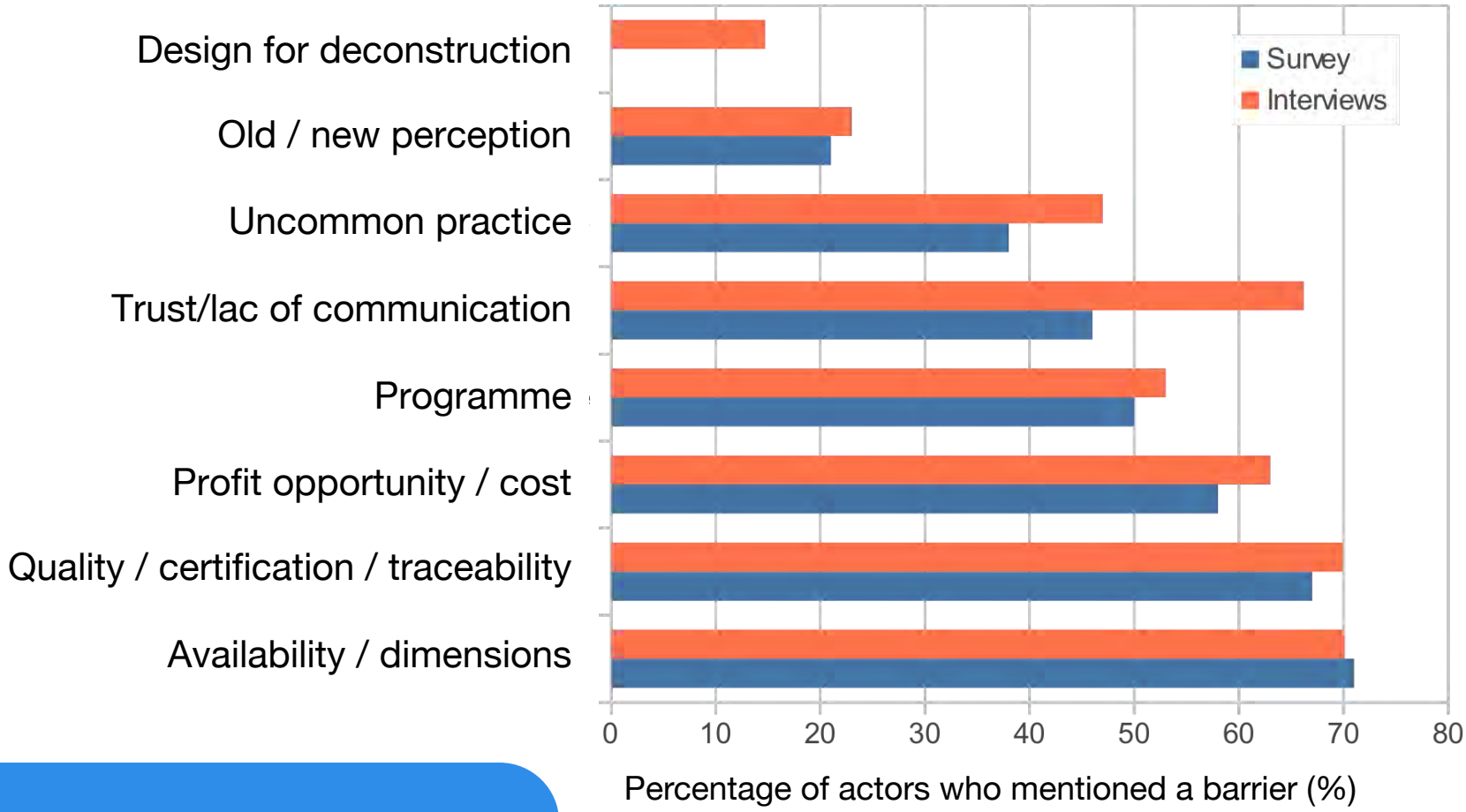
experience of steel reuse



38 interviewees from 30 semi-structured interviews

24 respondents to on-line surveys

interview and survey results



Similar scores for the survey and interviews gives confidence in the results

salience score

Salience is the state or condition of being prominent

$$\text{Salience score} = \frac{n_g}{N_g} \times \frac{N}{n_b}$$

n_g – number of mentions of barrier in group

N_g – number of respondents in group

N – total number of respondents

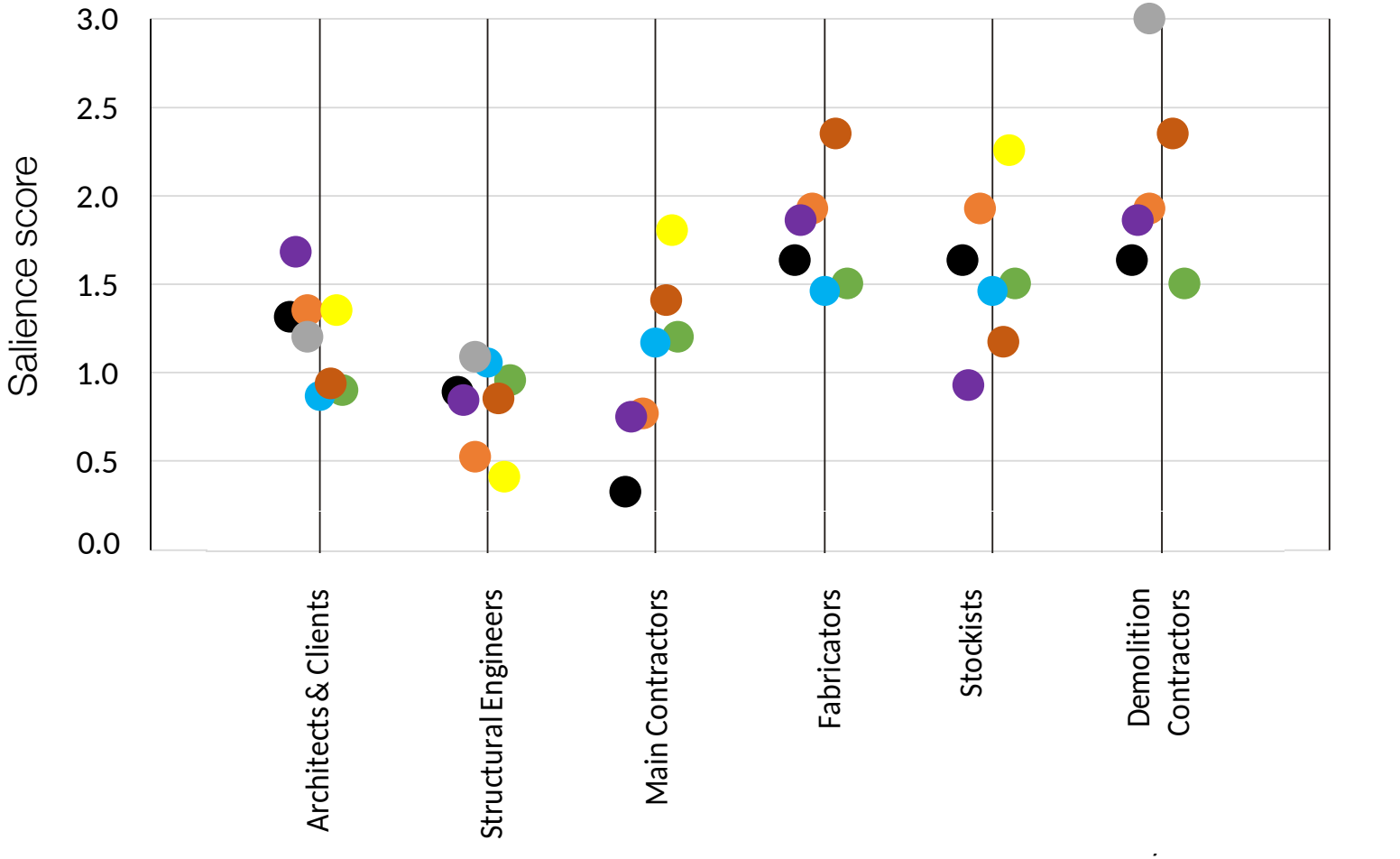
n_b – number of mentions of barrier

the importance of the barrier for the actor group

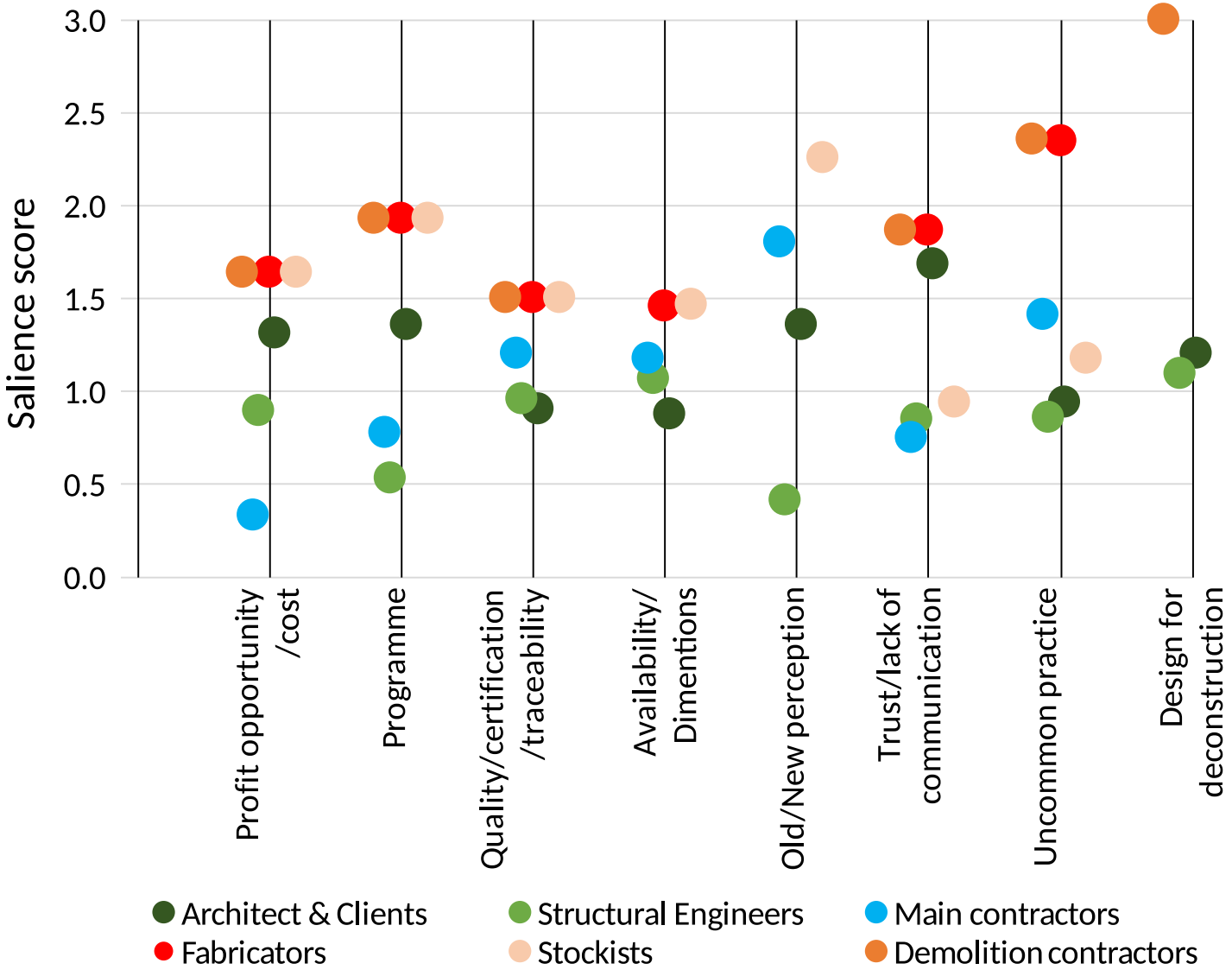
the inverse of the importance of the barrier across all interviewees

A higher salience score indicates that a barrier is particularly important to that actor

salience : barrier ranking, by actor

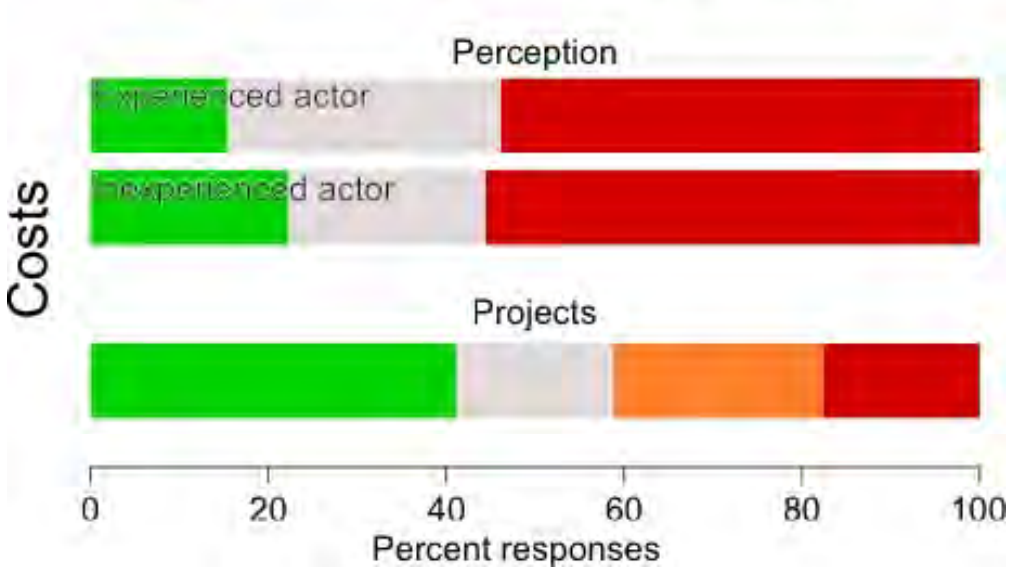


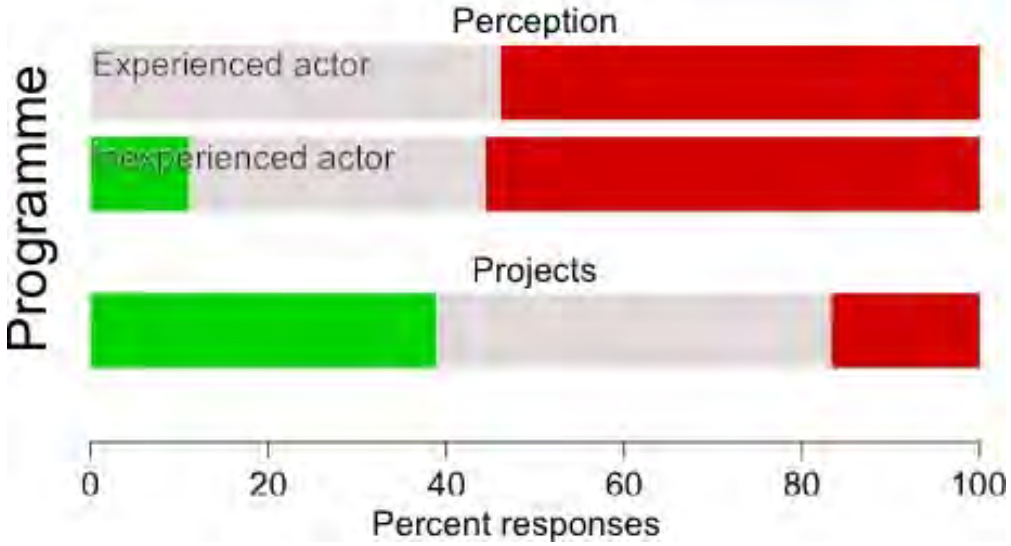
salience : actor ranking, by barrier

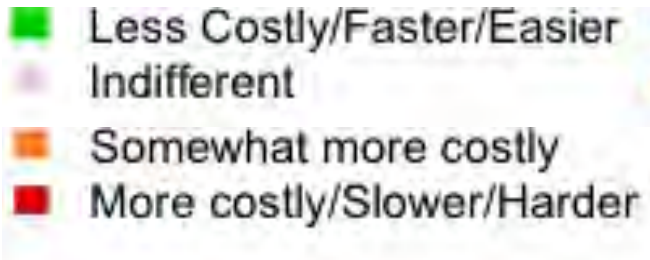


perception of costs and programme

Perceptions taken from the on-line survey







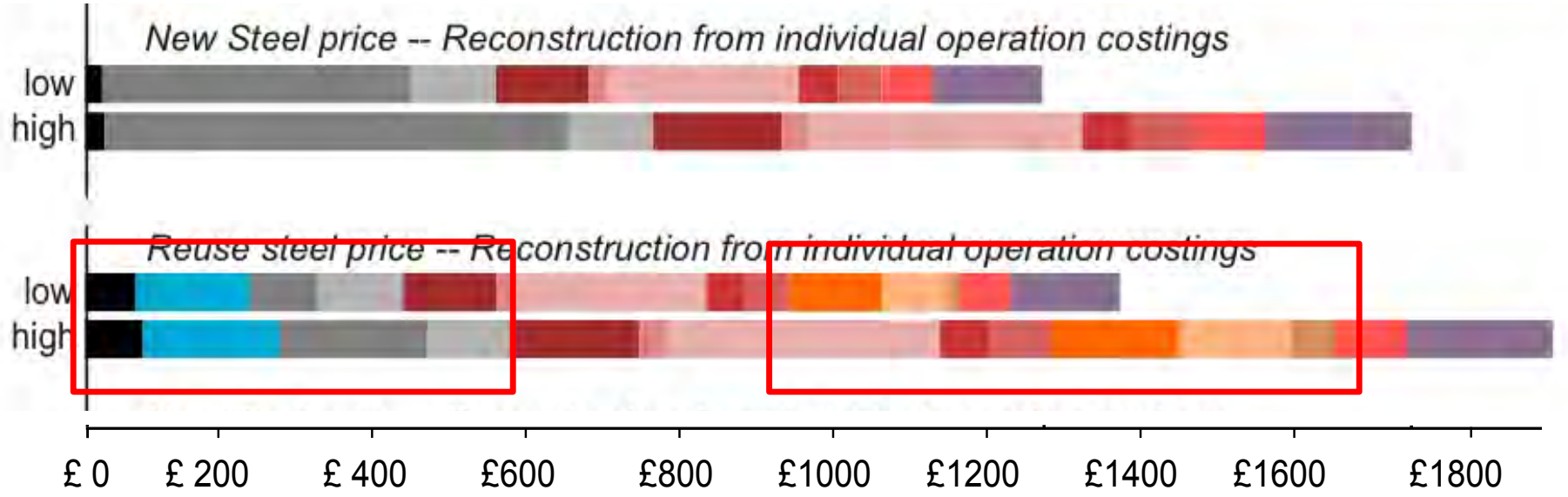
the costs of structural steel reuse

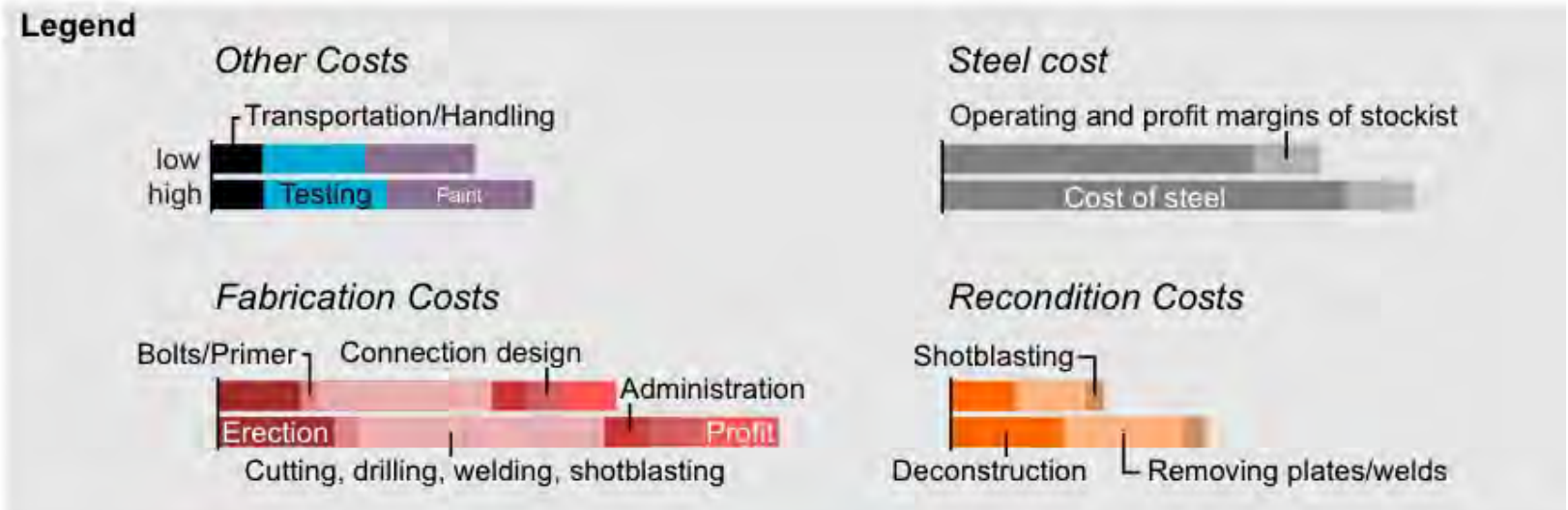
costs considered

- Transport and handling
- Storage/administration
- Price of steel elements
- Premium for uncommon sections
- Connection design
- Profit margin
- Fabrication operations
  recondition costs, cutting, welding, drilling, etc.
- Materials
  bolts, primer
- Erection
- Deconstruction
  as opposed to demolition
- Testing and certification
- Coating and fire protection

Costs were reconstructed from the information given in interviews

the cost structure for reuse





the cost structure for reuse

The cost of reusing steel at scale is at least as expensive as new steel

successful reuse case studies?

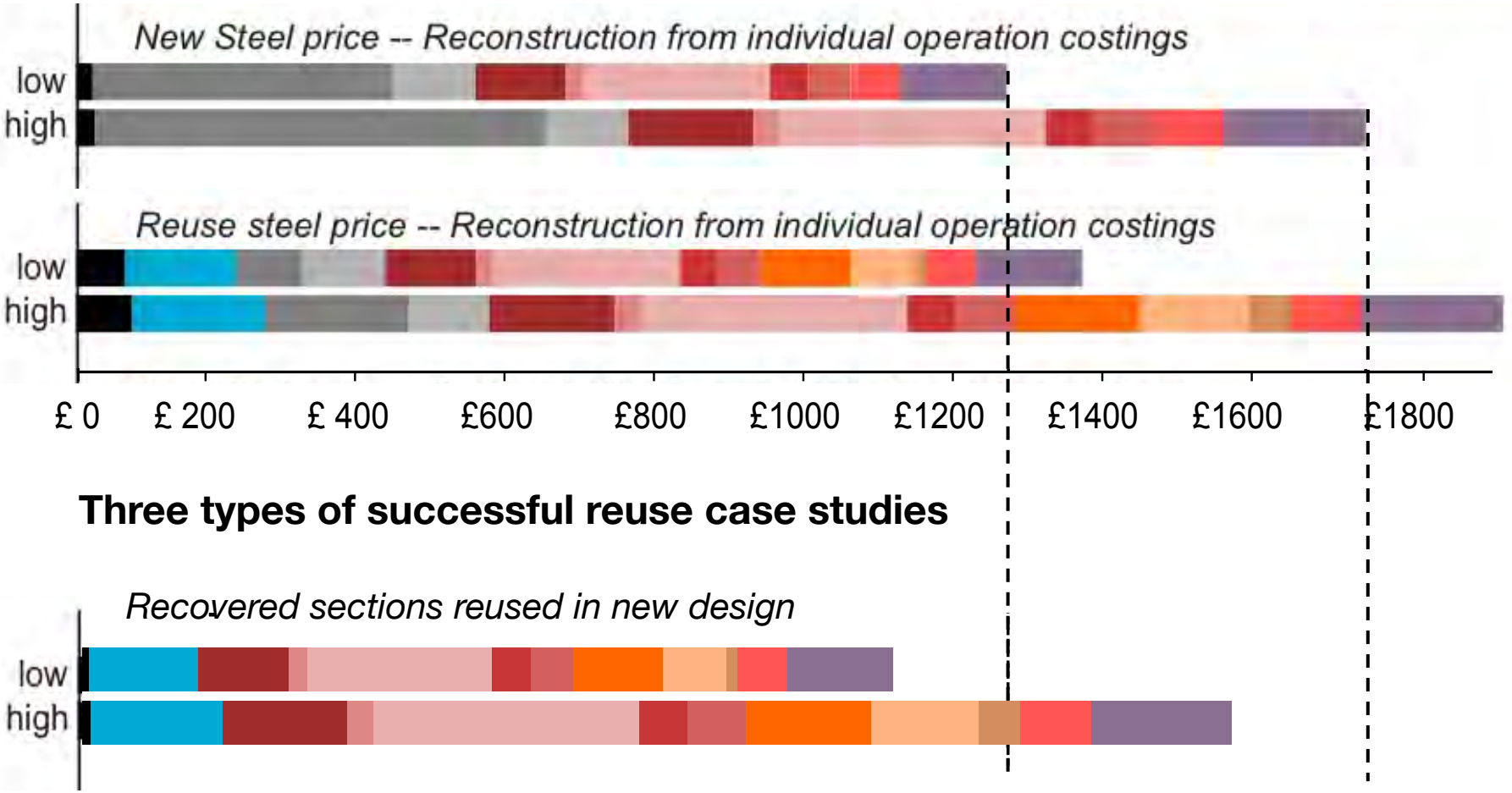






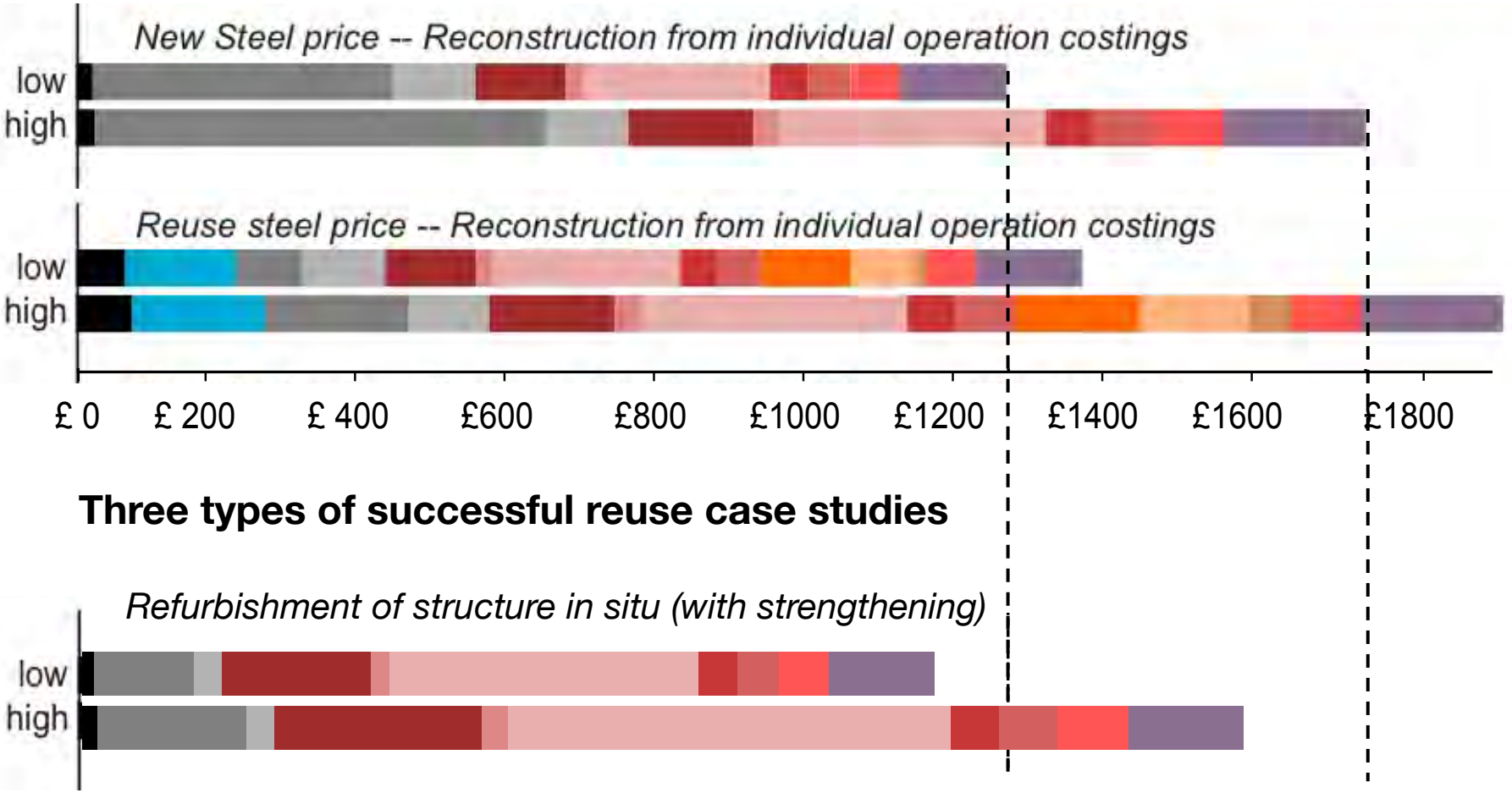

three types of
successful case study

successful reuse case studies



- minimal sourcing or stocking of steel required (grey)
- transport costs are minimised (black); testing or engineering judgement
- examples: BedZED, Carwood Park, 740 Rue Bel-Air

successful reuse case studies

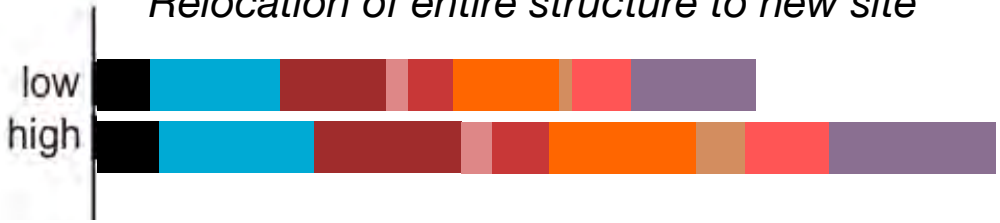


- testing costs are eliminated (grey), but onsite fabrication increases (pink)
- transport (black) and stocking (light grey) costs are reduced
- examples: Blue Steel, Kings Science, UTC

successful reuse case studies

Three types of successful reuse case studies

Relocation of entire structure to new site



- minimal sourcing or stocking of steel required (grey)
- testing required (blue), fabrication costs are reduced (pink)
- examples: Segro, Honda Warehouse, Portal Power

Conclusions

Conclusions

Motivation

- The economic margin and availability of old steel sections appear to favour reuse
- Several successful case studies of structural steel reuse exist

Conclusions

Findings

- Different barriers to reuse affect different actors along the supply chain
- Barriers are most salient for fabricators, stockists and demolition contractors
- Barrier perception and reality are not always aligned

Conclusions

Findings

- The costs of reusing structural steel at scale are at least as high as specifying new steel
- Successful examples of reuse can be explained by the elimination of one or more of the cost components
- Three types of successful case studies are identified:
  - Recovered sections reused in new design
  - Refurbishment of structure in situ (with strengthening)
  - Relocation of entire structure to new site

thank you

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