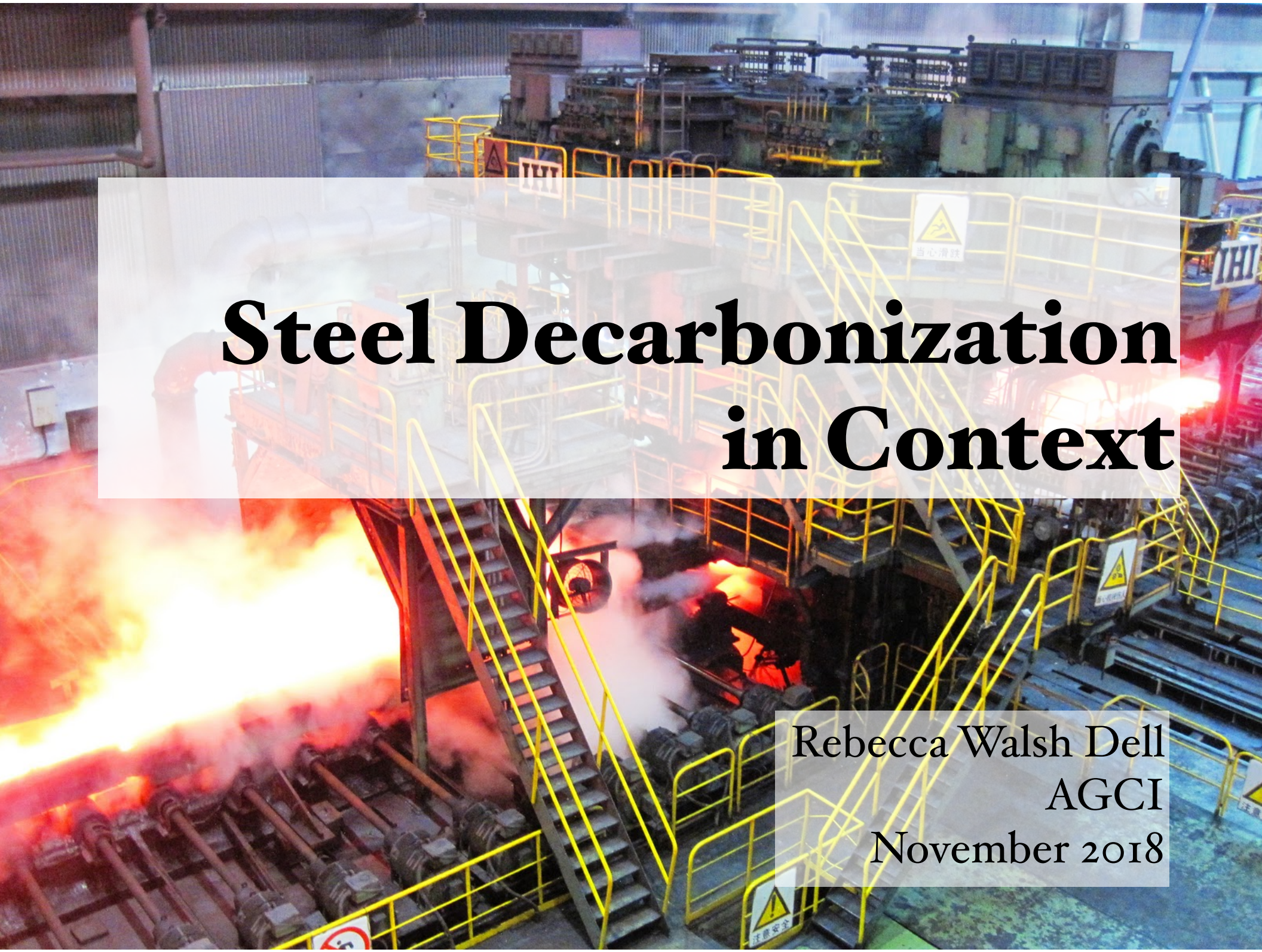
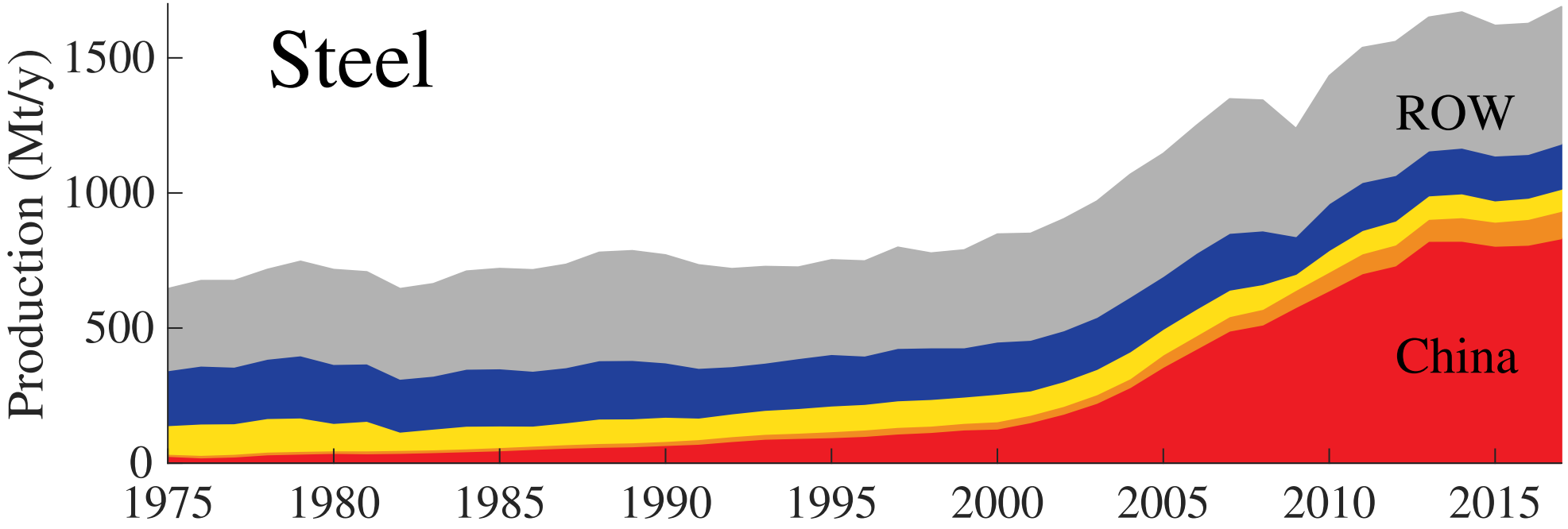


Steel Decarbonization in Context

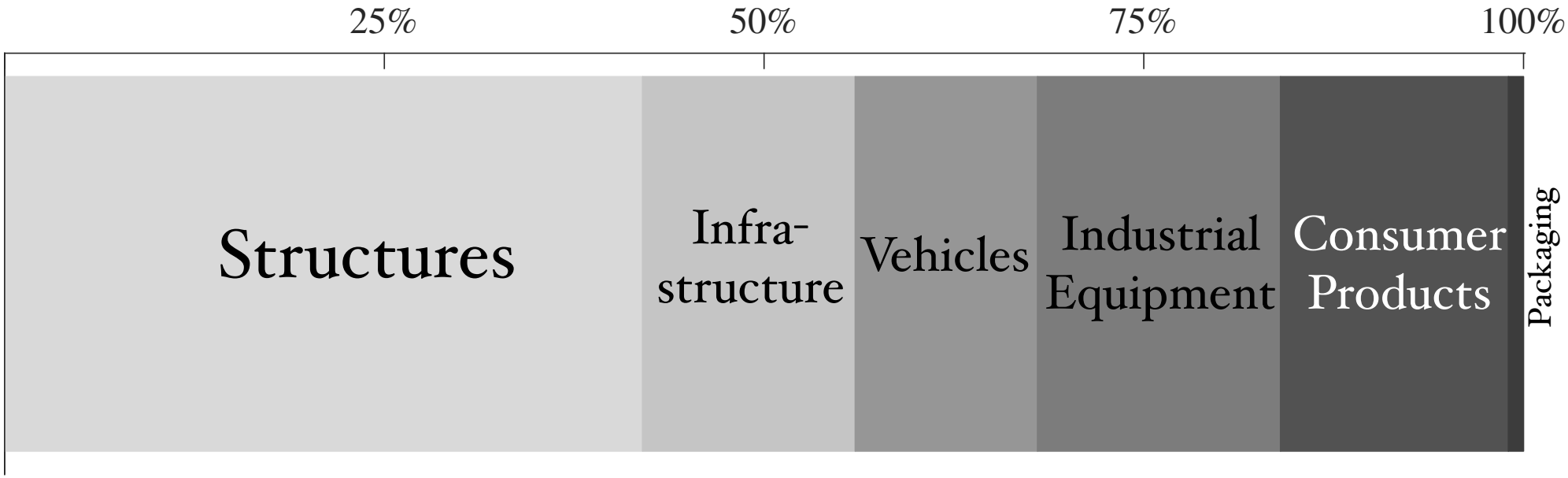
Rebecca Walsh Dell
AGCI
November 2018

On average, every one of us has 220 kg of steel produced per year on our behalf.



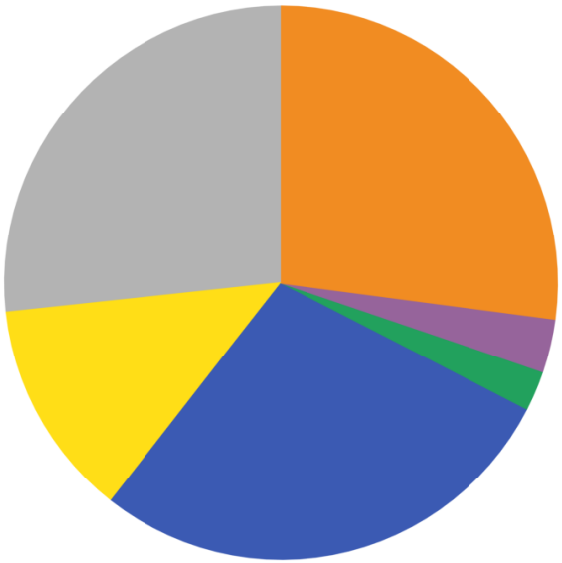
Source: WSA (2017).

We use it for everything, but mostly big things.



Source: Allwood and Cullen (2015).

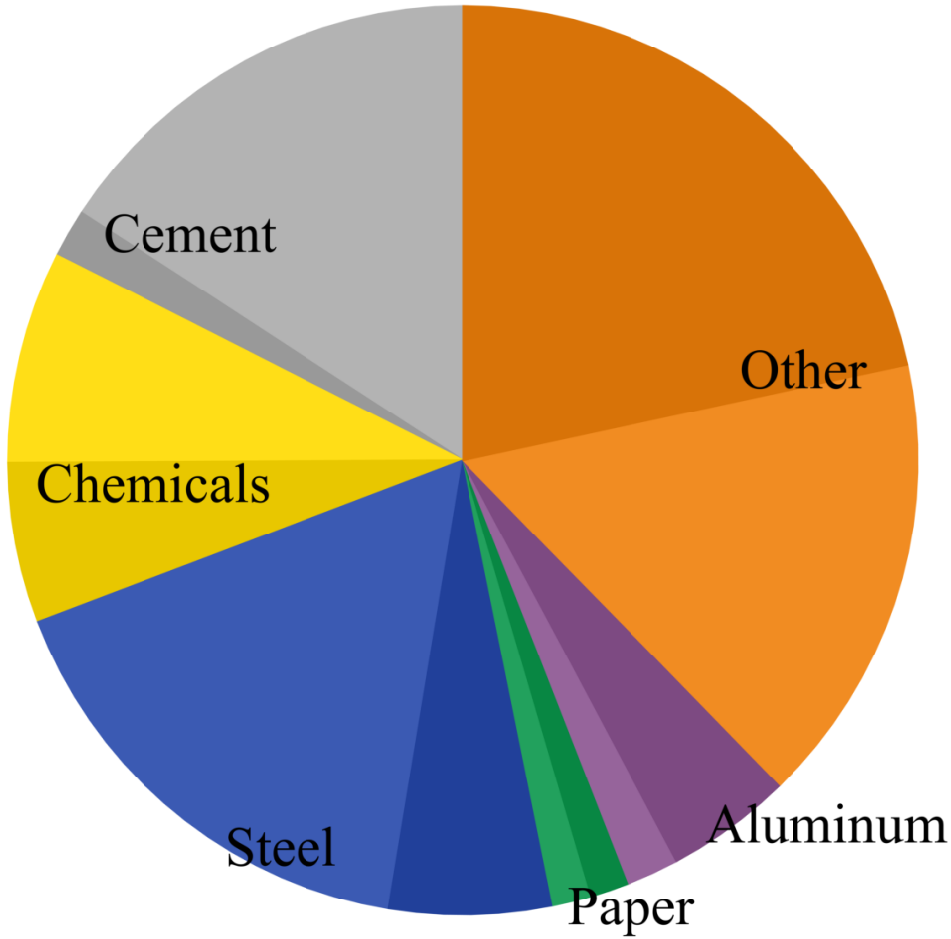
Steel has the highest emissions of any industrial sector.



n

Total: 8.3 $GtCO_2$ (2014)

Direct Emissions Only

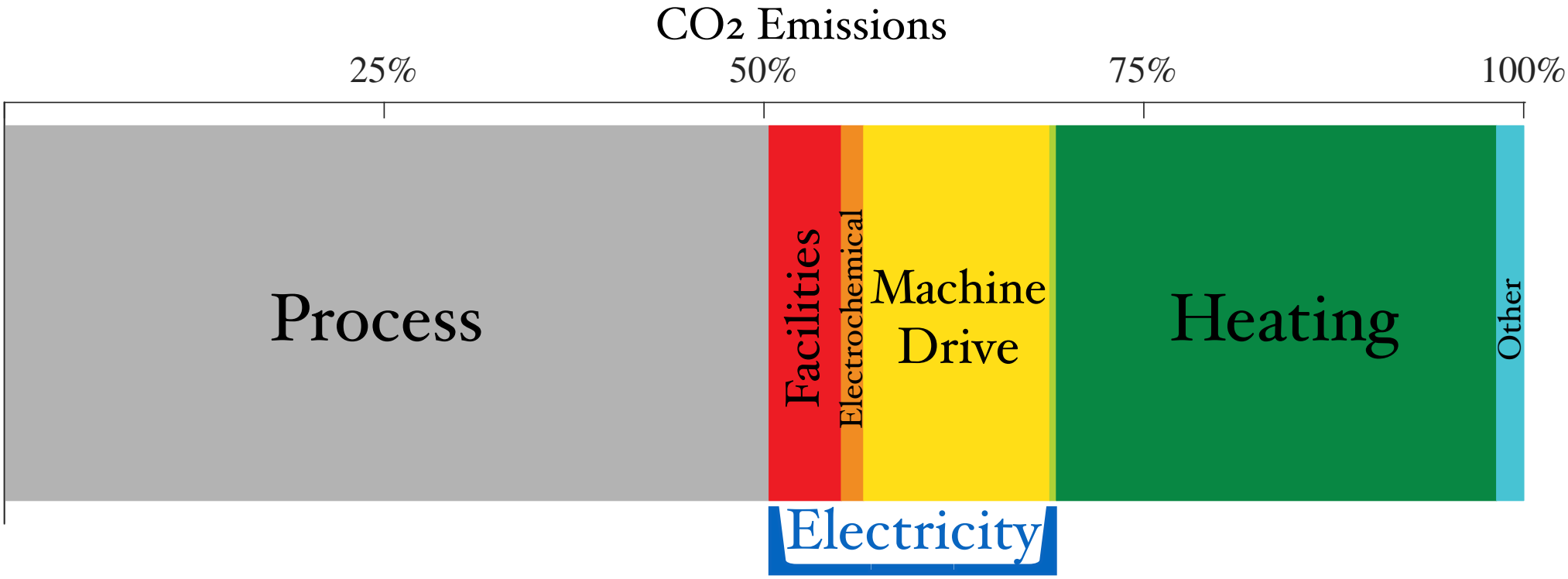


Total: 14.1 $GtCO_2$ (2014)

Including Power Emissions

Source: IEA *ETP 2017.*

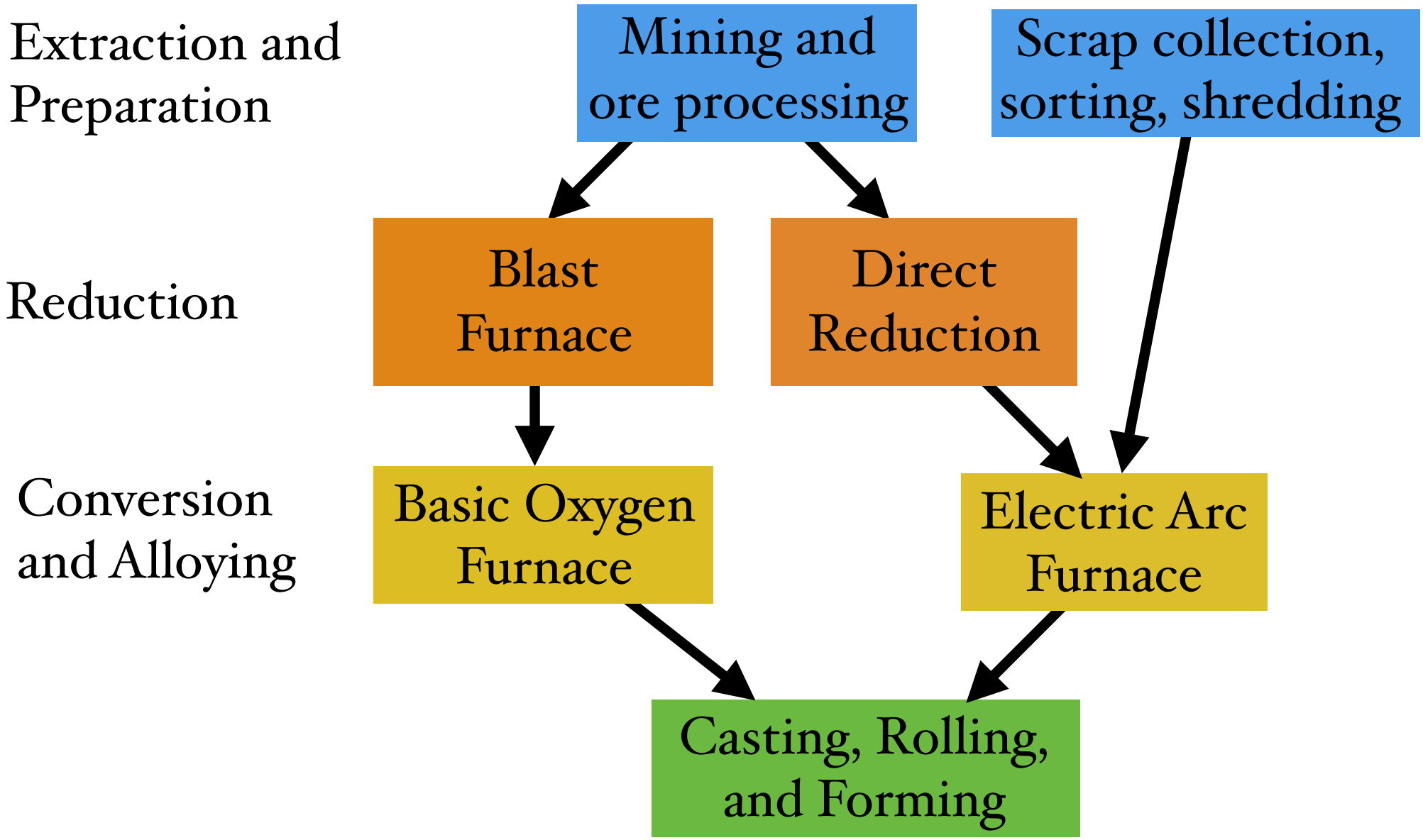
Process emissions are about half of steel emissions.



$$Fe_3O_4 + 2\ C + heat \rightarrow 3\ Fe + 2\ CO_2$$

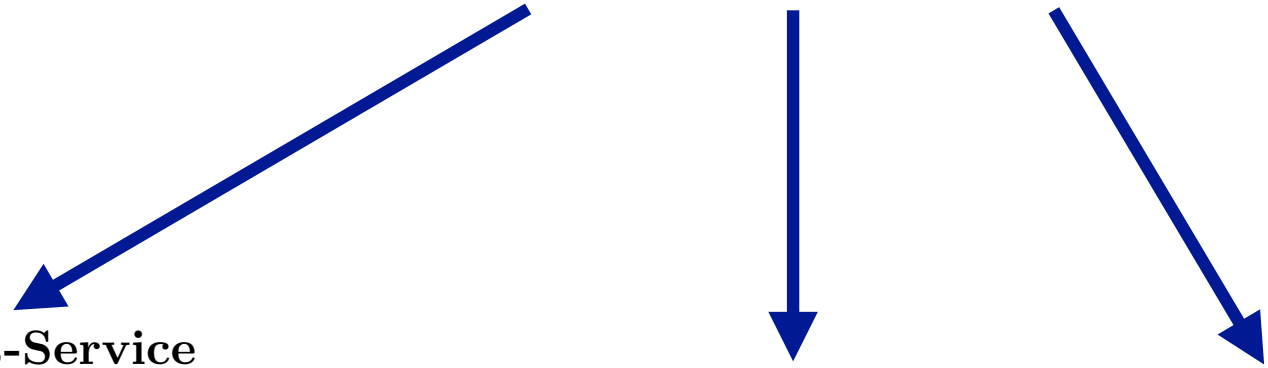
Source: DOE (2014) and EPA (2018).

Steel has a few production pathways, and they all have the same steps.



Emissions reductions come in three basic categories.

$$GHG = S \times \frac{P}{S} \times \frac{M}{P} \times \frac{GHG}{M}$$



Product-Service Intensity
Precision application
Increased product lifetimes
Reuse
Increased utilization

Materials Intensity
Substituting low-C materials
Light-weighting
Process waste reduction
Recycling

Emissions Intensity
CCS
Fuel switching
Bio-energy
Energy efficiency
Innovative processes

Opportunities abound to increase product lifetimes.

Durable Goods	**Typical Lifetime in China**	**Typical Lifetime in US/OECD**
Buses	6-7 years	12 years
Taxis	600,000 km	750,000+ km
Residential Buildings	33 years	75-80 years
Civil Engineering Works	30 years	60 years

Sources: BTS (2017, Tables 1-26 and 1-29), Gong (2018), Xi et al. (2016), Cao et al. (2017).

Buildings can be reused, as well as their components.

Sources: skyscrapercentre.com, 300 Randolph St., and Allwood and Cullen (2015).

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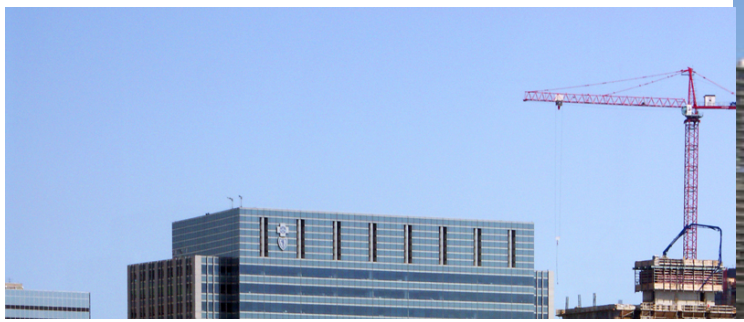

Sources: skyscrapercentre.com, 300 Randolph St., and Allwood and Cullen (2015).

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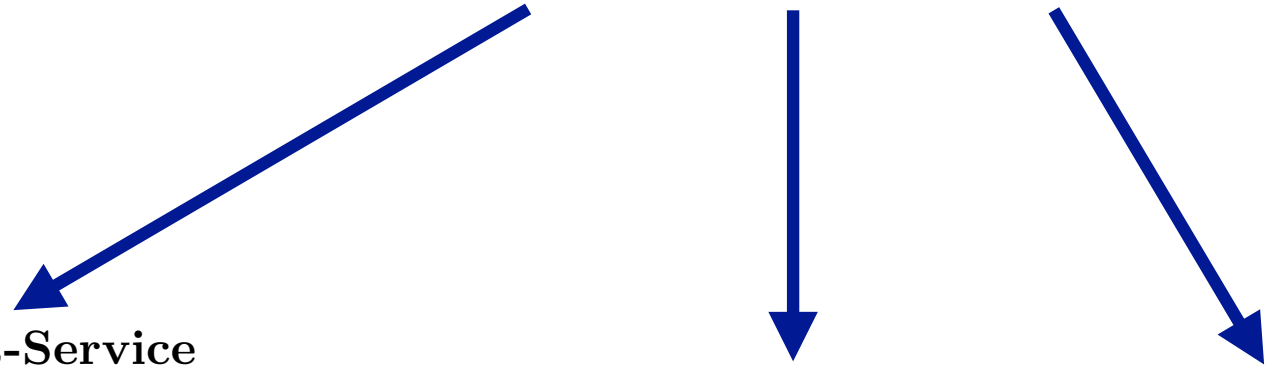

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Modern timber products can substitute for steel in many contexts.

Source: Wood Innovation and Design Centre of Canada (2014).

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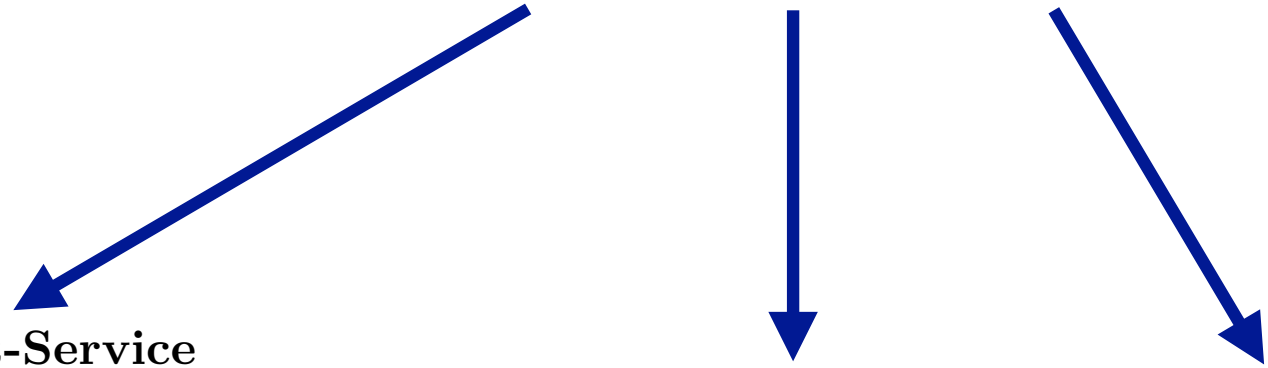

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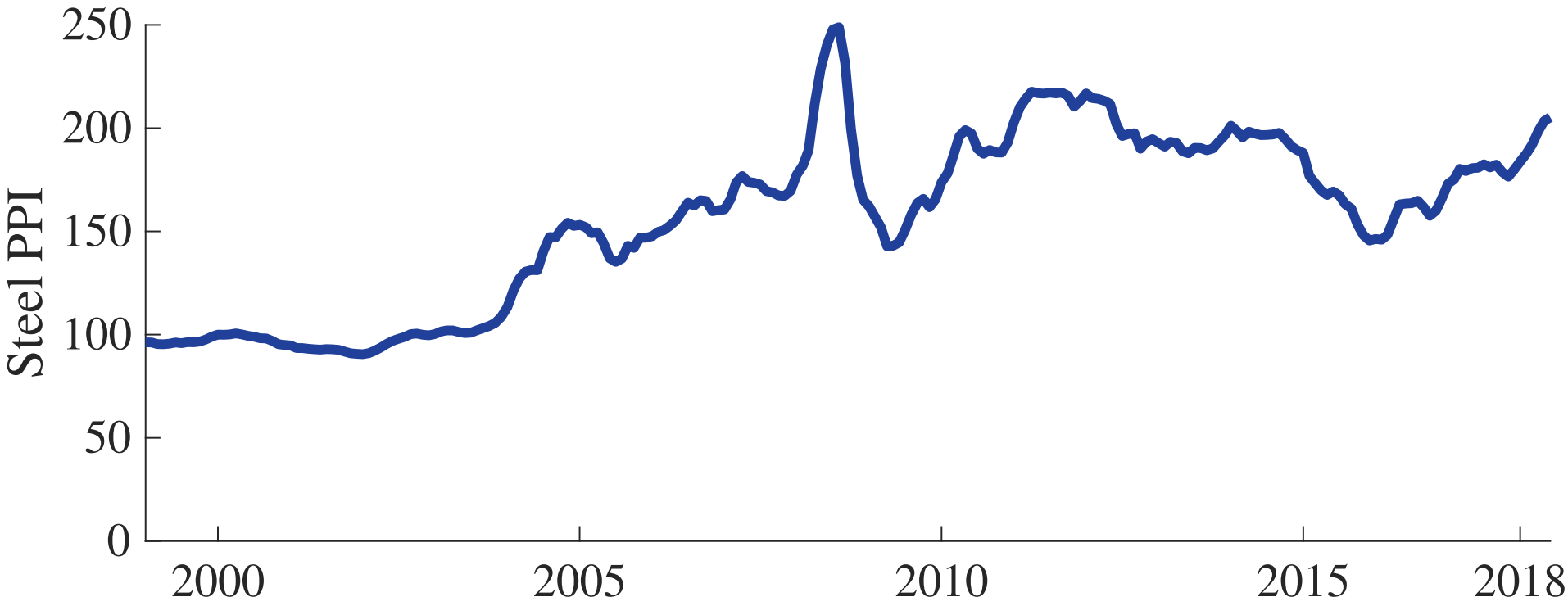
Economic conditions make the steel sector particularly resistant to change.



Headwinds include:

- Large-scale production
- Geographic concentration
- Trade exposure
- Long-lived capital
- Over-capacity
- Weak balance sheets

Source: U.S. BLS (2018)