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Options to supply the UK steel demand and meet the CO₂ targets

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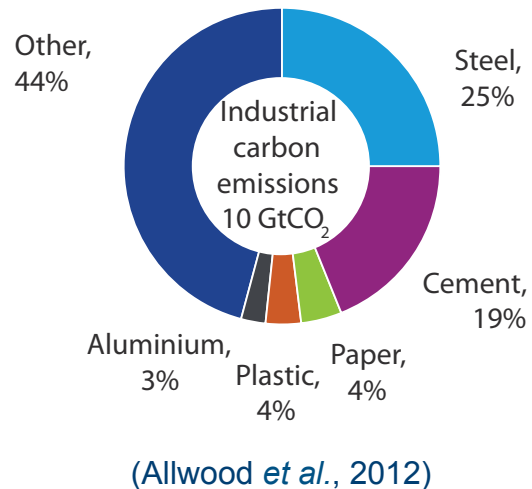
Jonathan Cullen, University of Cambridge

Julian Allwood, University of Cambridge

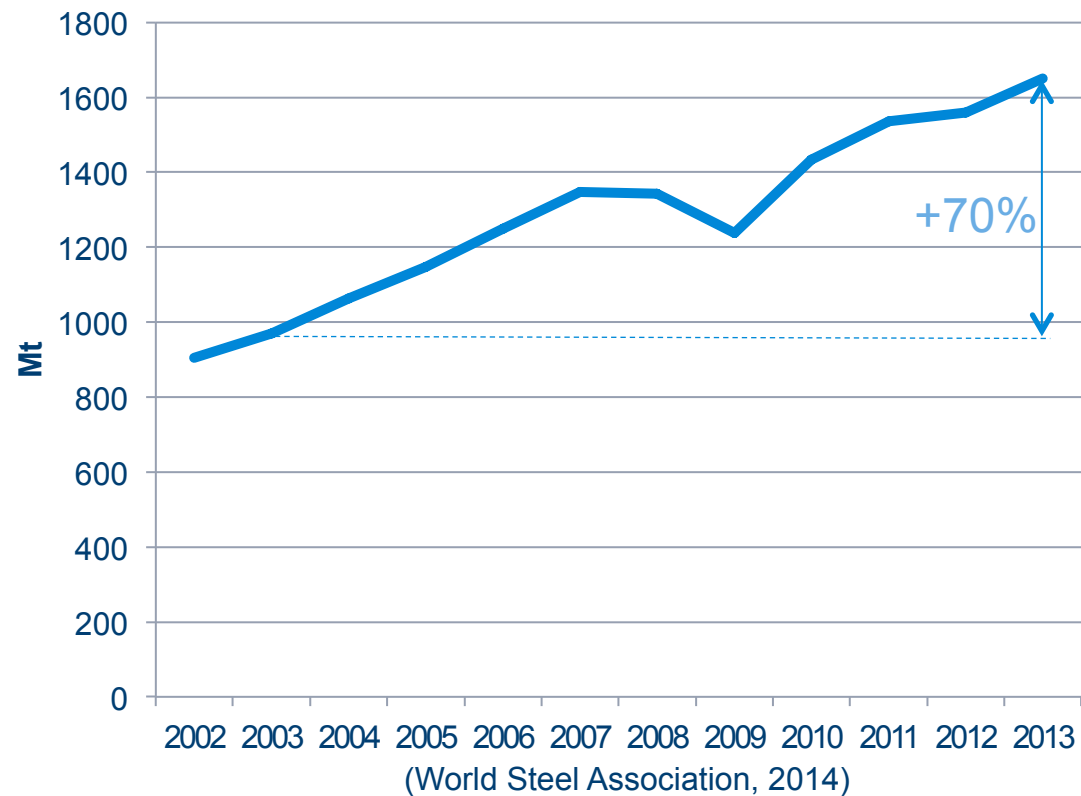
ISIE Conference 2015, Guildford, UK
July 10th, 2015

Steel global production and impacts

Global industrial CO₂ emissions, 2005



Global crude steel production



Reducing steel industrial emissions and supply future demand

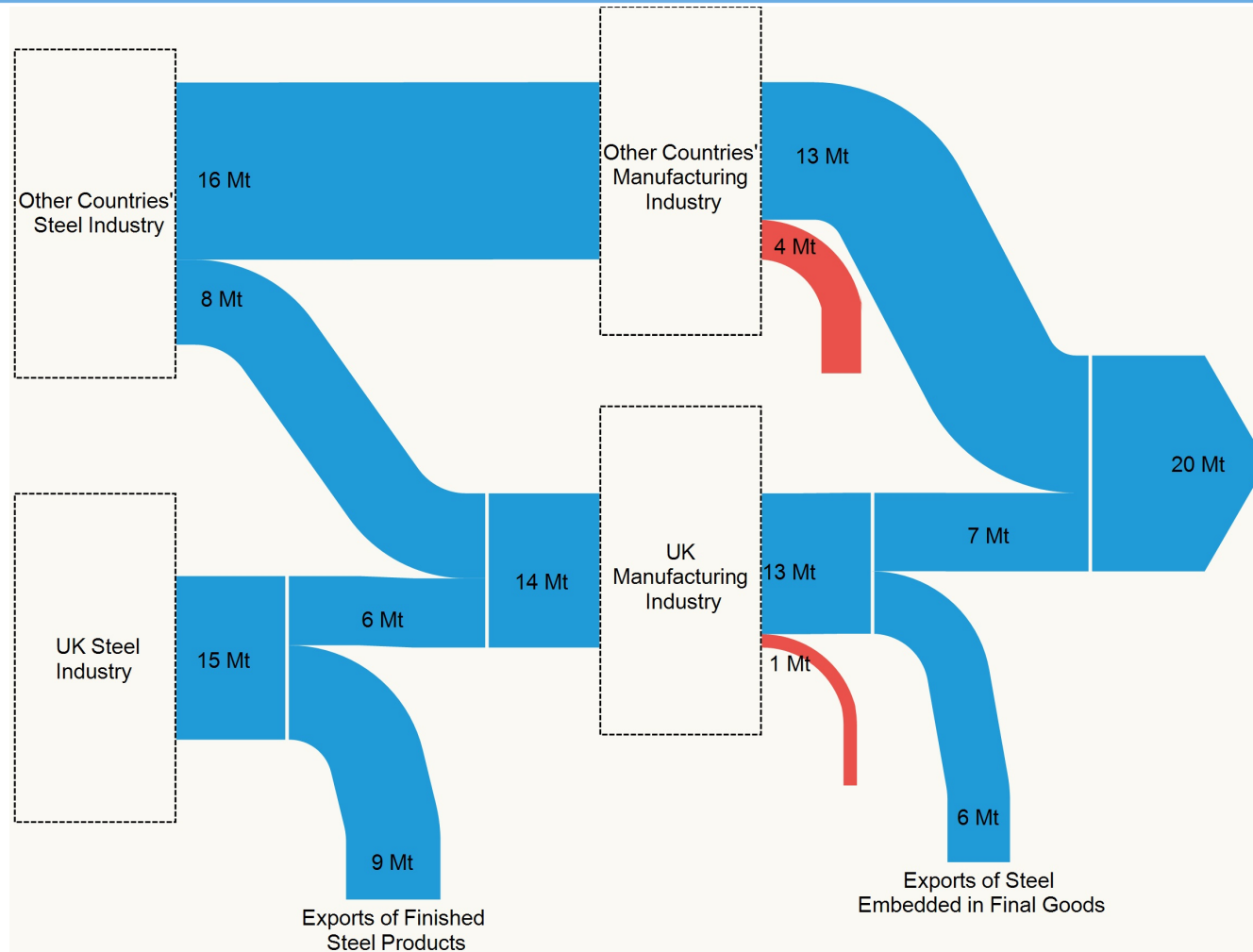
How can steel industry emissions be reduced?

1. Switching to more efficient production routes;
2. Increasing the efficiency of current production routes;
3. Reducing steel demand.

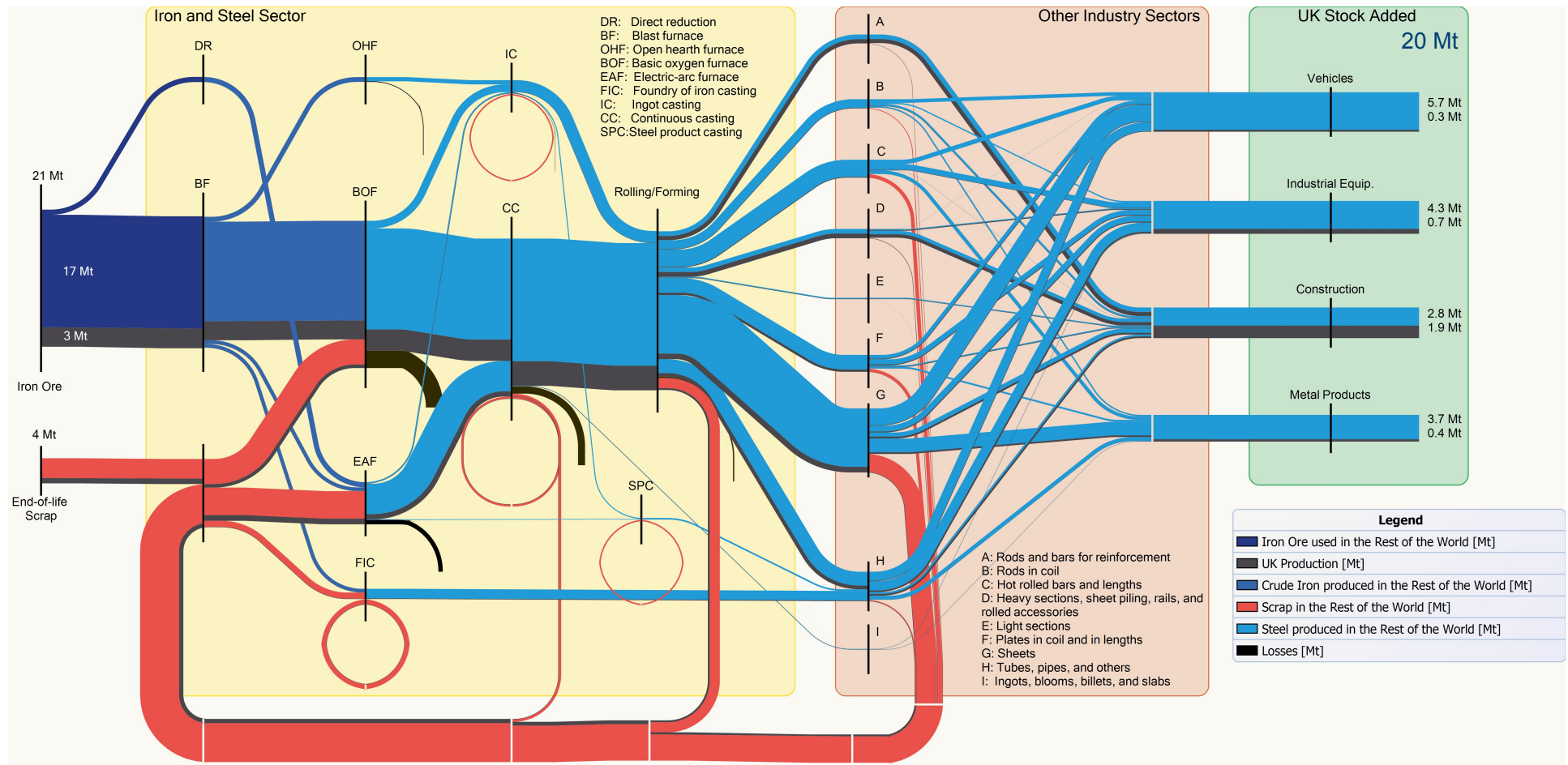
In the UK:

- The Government has committed to a reduction of UK GHG emissions to 80% of the 1990 levels by 2050.
- **How to supply future demand for steel in the UK and meet this climate target?**

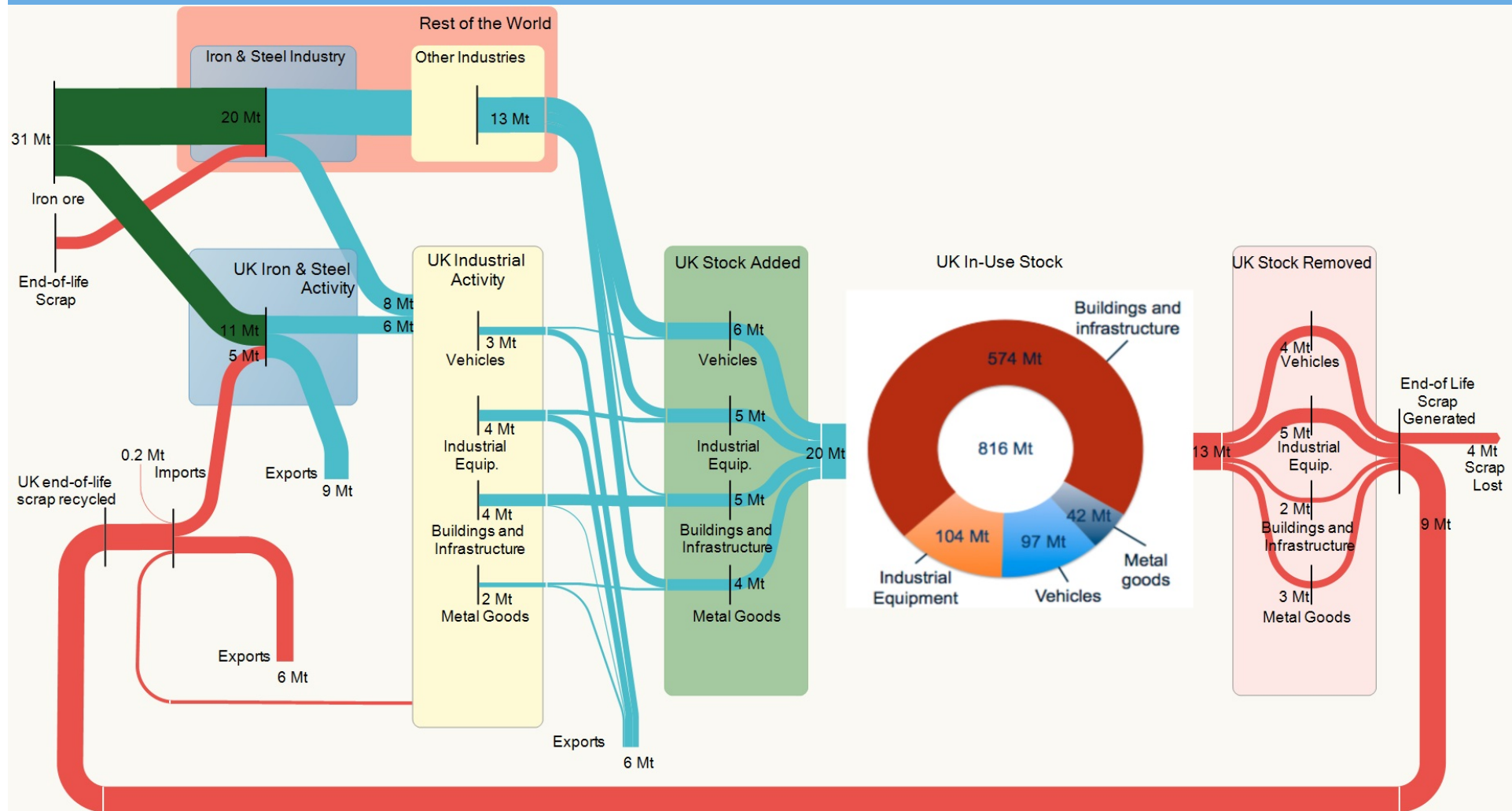
Steel flow to supply the UK demand, 2007



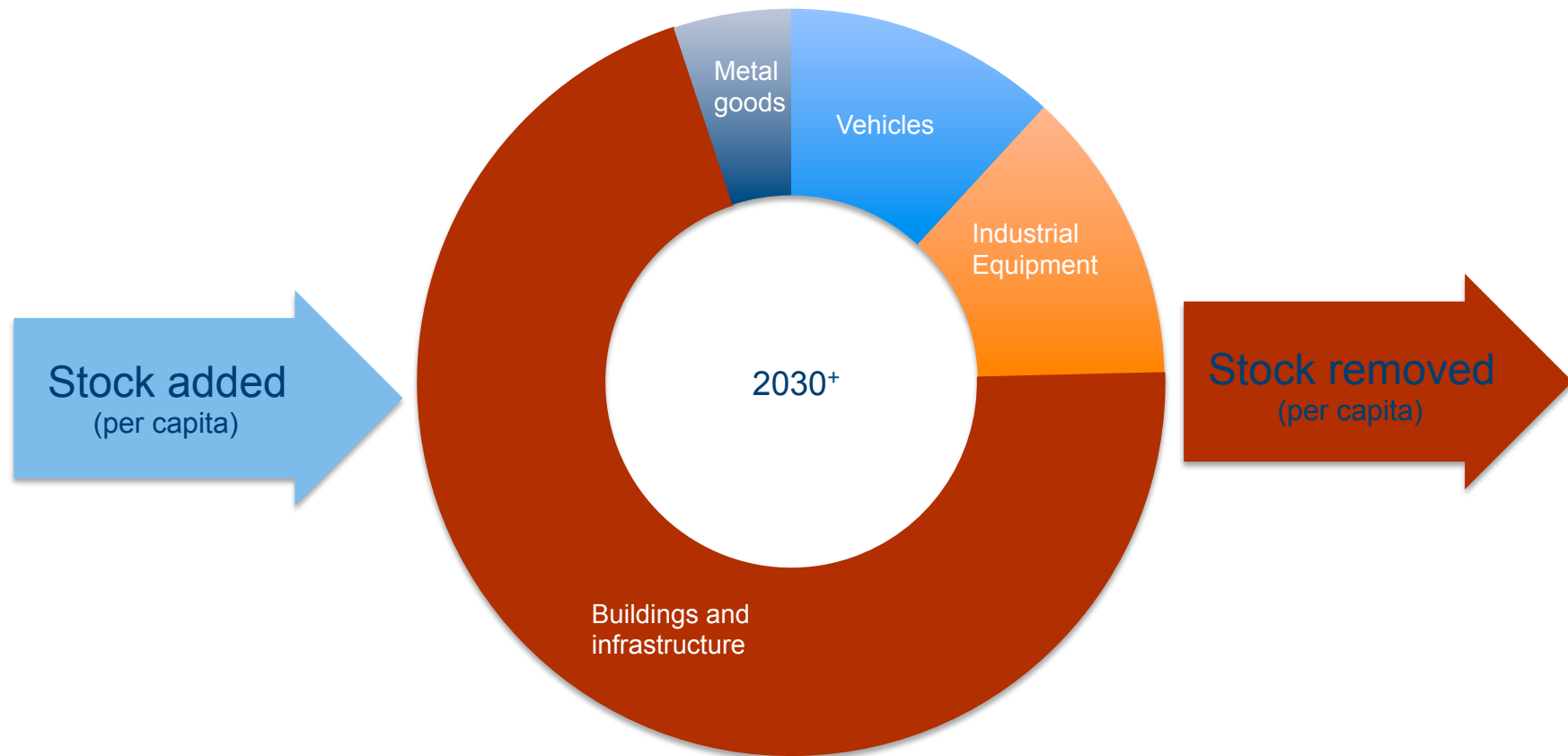
Steel flow to supply the UK demand, 2007



Steel added / removed from in-use stock, UK 2007



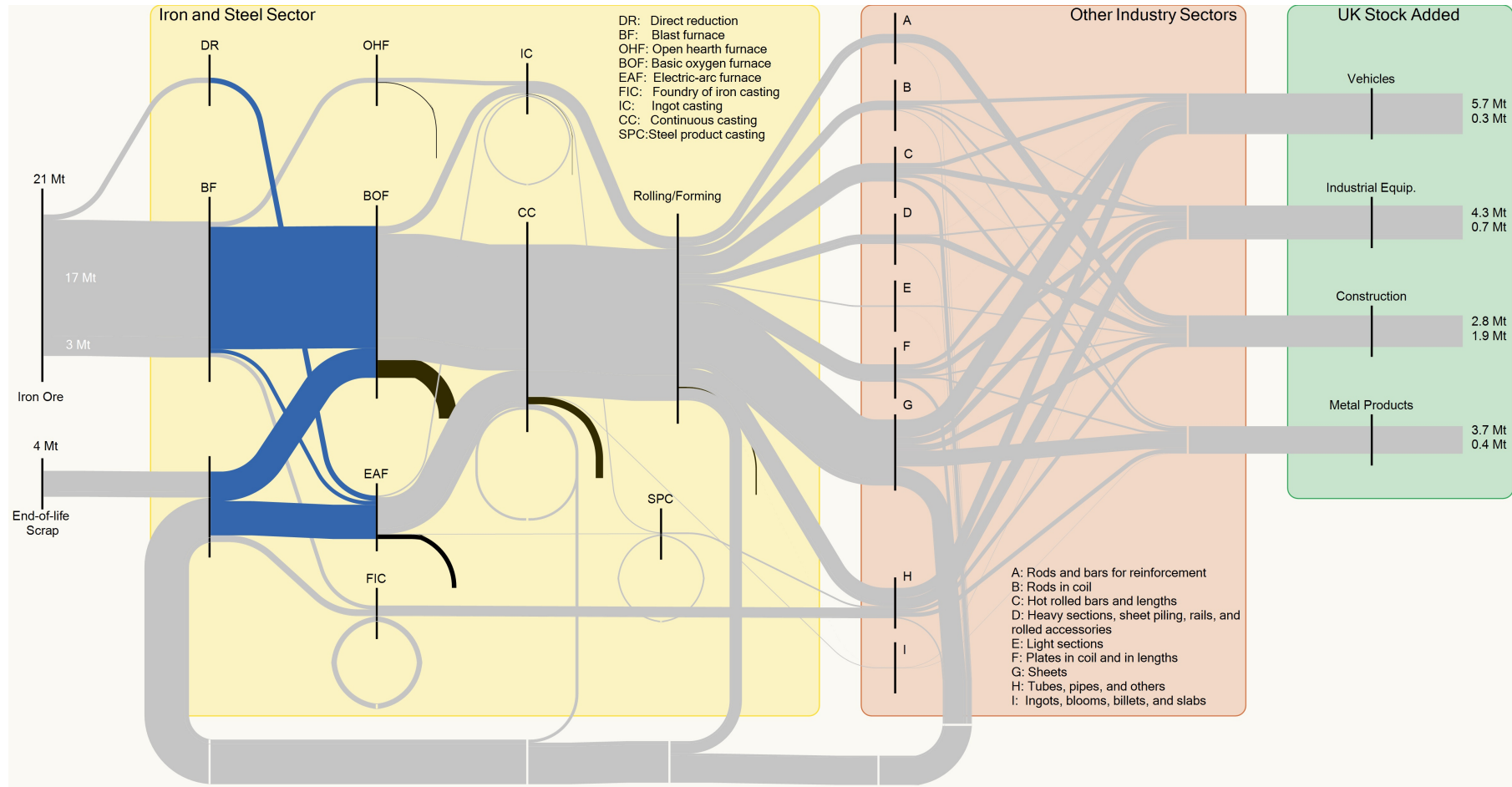
In-use stock saturation



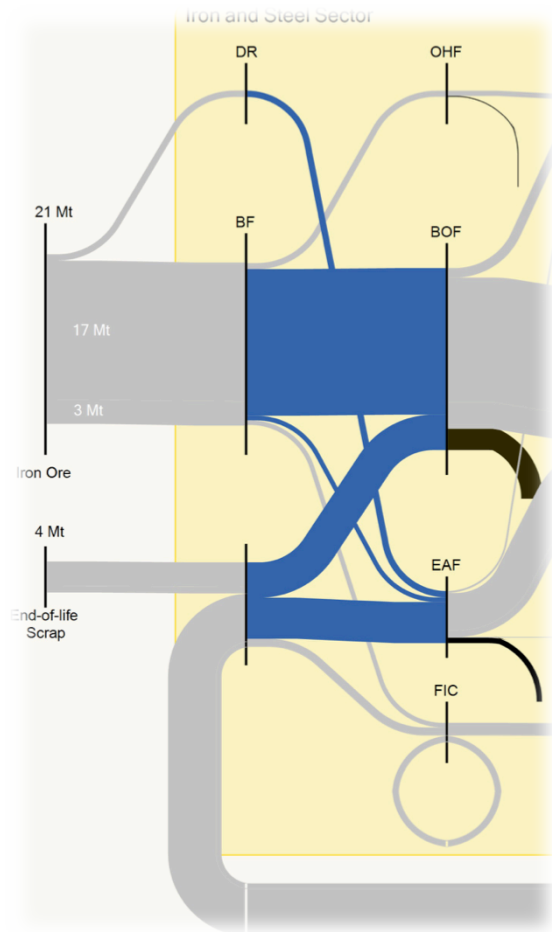
Estimating future UK crude steel demand

Product categories	Saturation stock [tonnes per capita] (Pauliuk et al., 2013)	Average lifetime [years] (Pauliuk et al., 2013)	Demand for new steel additions to stock [Mt]	Demand for crude steel [Mt]
Vehicles	1.3	20	5.4	7.4
Industrial equipment	0.9	30	2.6	3.4
Buildings and infrastructure	10.0	75	13.3	16.4
Metal goods	0.6	15	3.3	4.6
Total	12.8		24.5	31.7

Options for future UK steel production



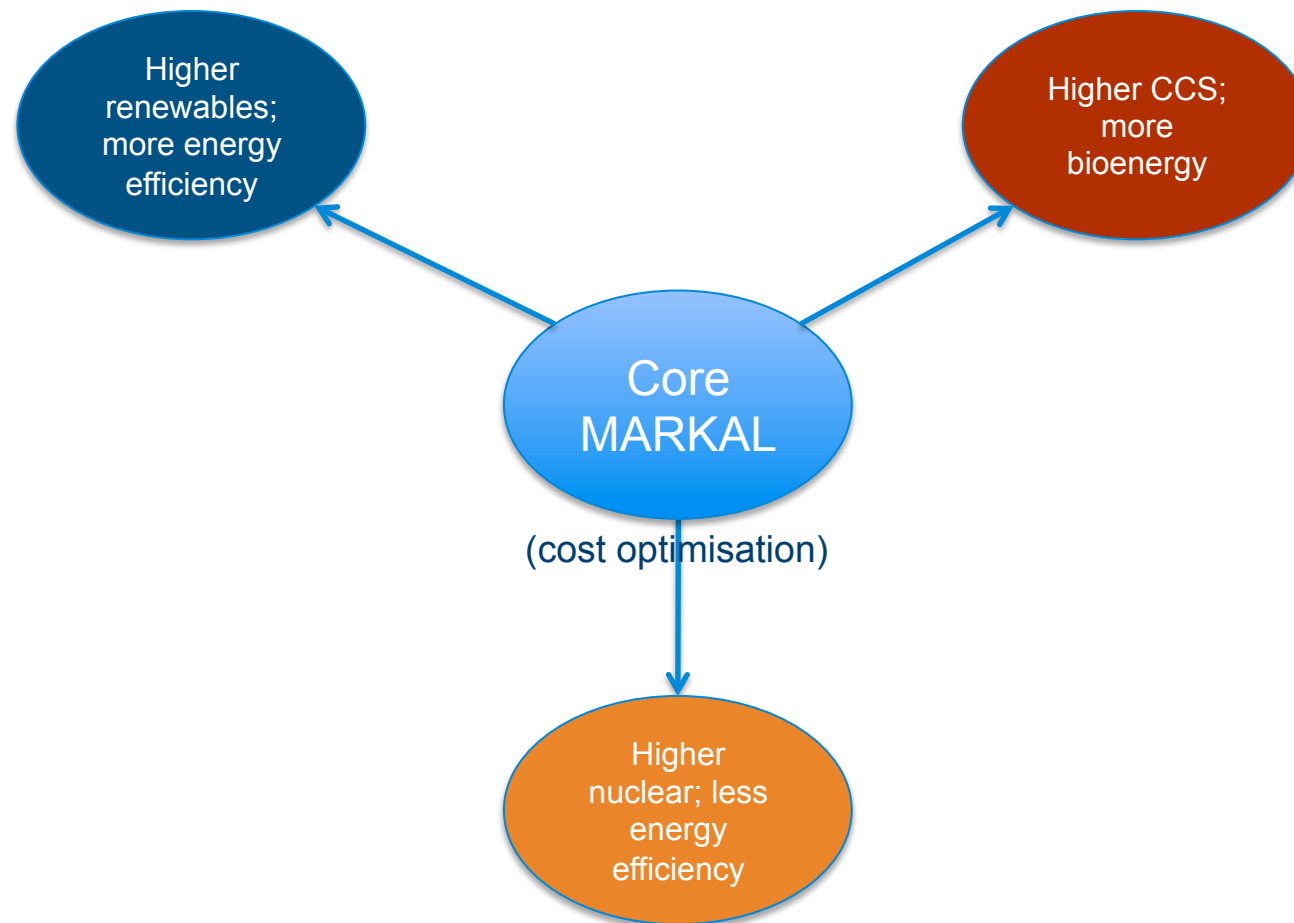
Options for future UK steel production



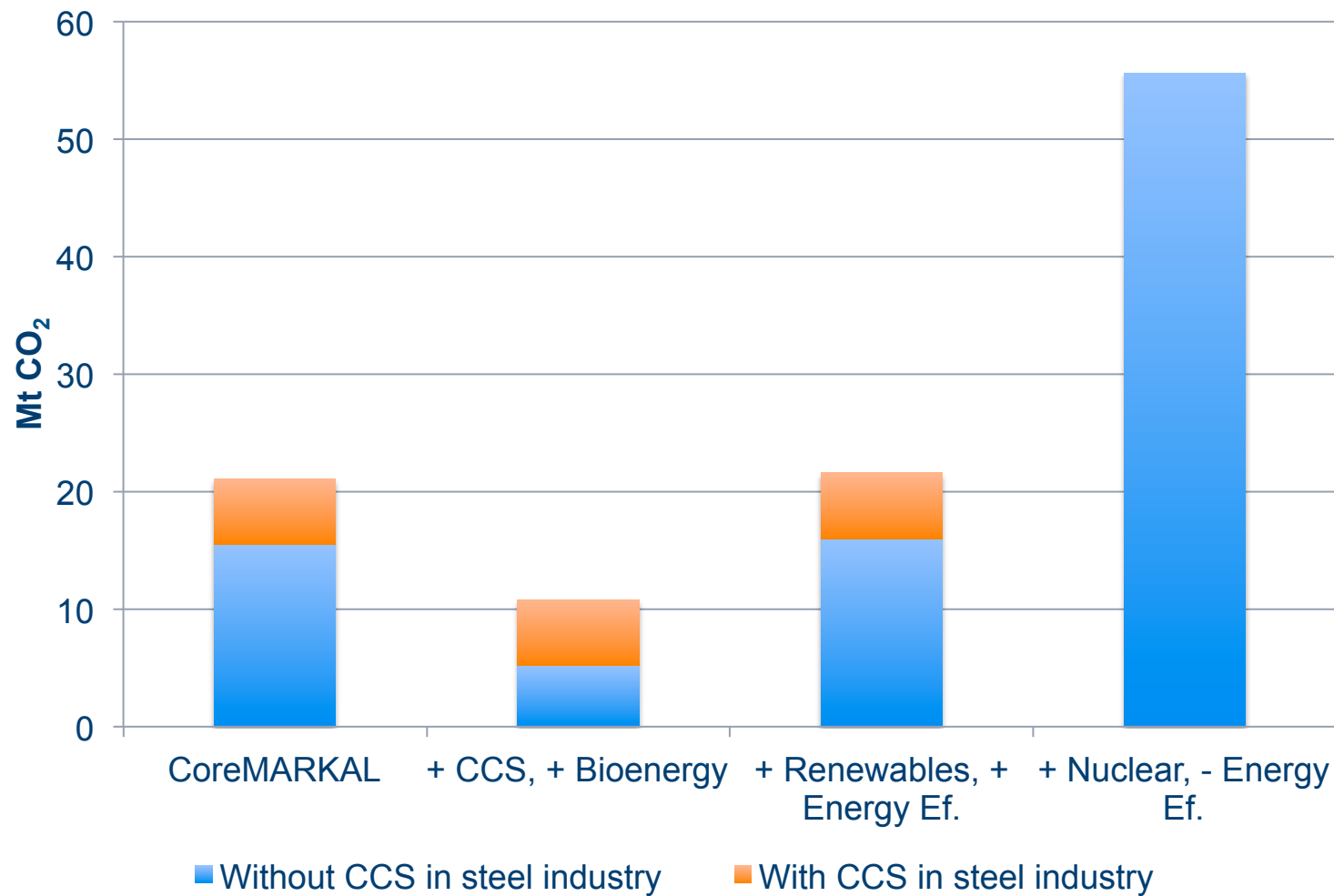
Iron sources	A	B	C	D	E
Hot metal from BF	67%	84%	5%	—	—
DRI	—	—	—	25%	50%
Scrap	33%	16%	95%	75%	50%

UK Carbon Plan Pathways

4 pathways for a low carbon future:



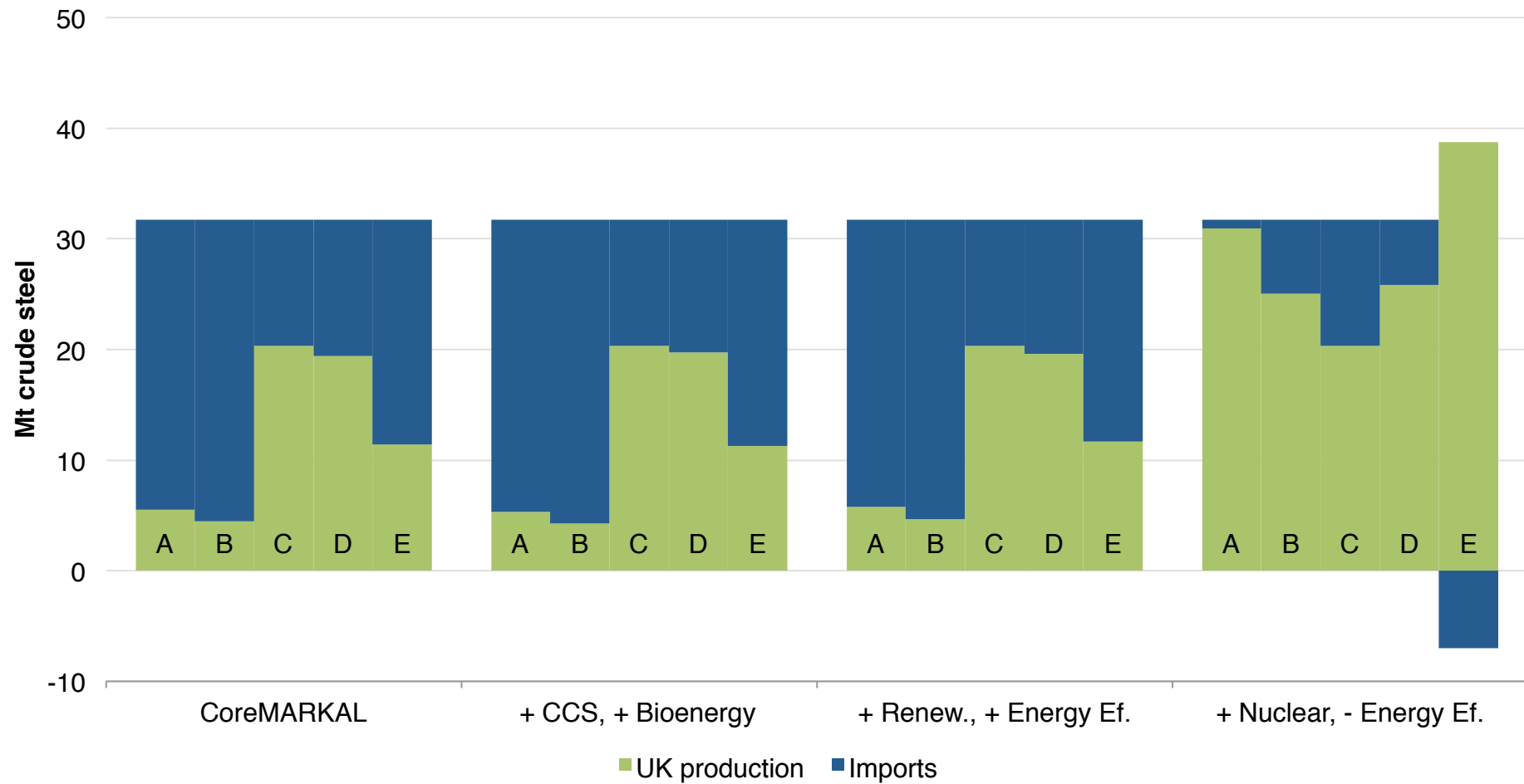
Emissions for the UK steel industry in 2050



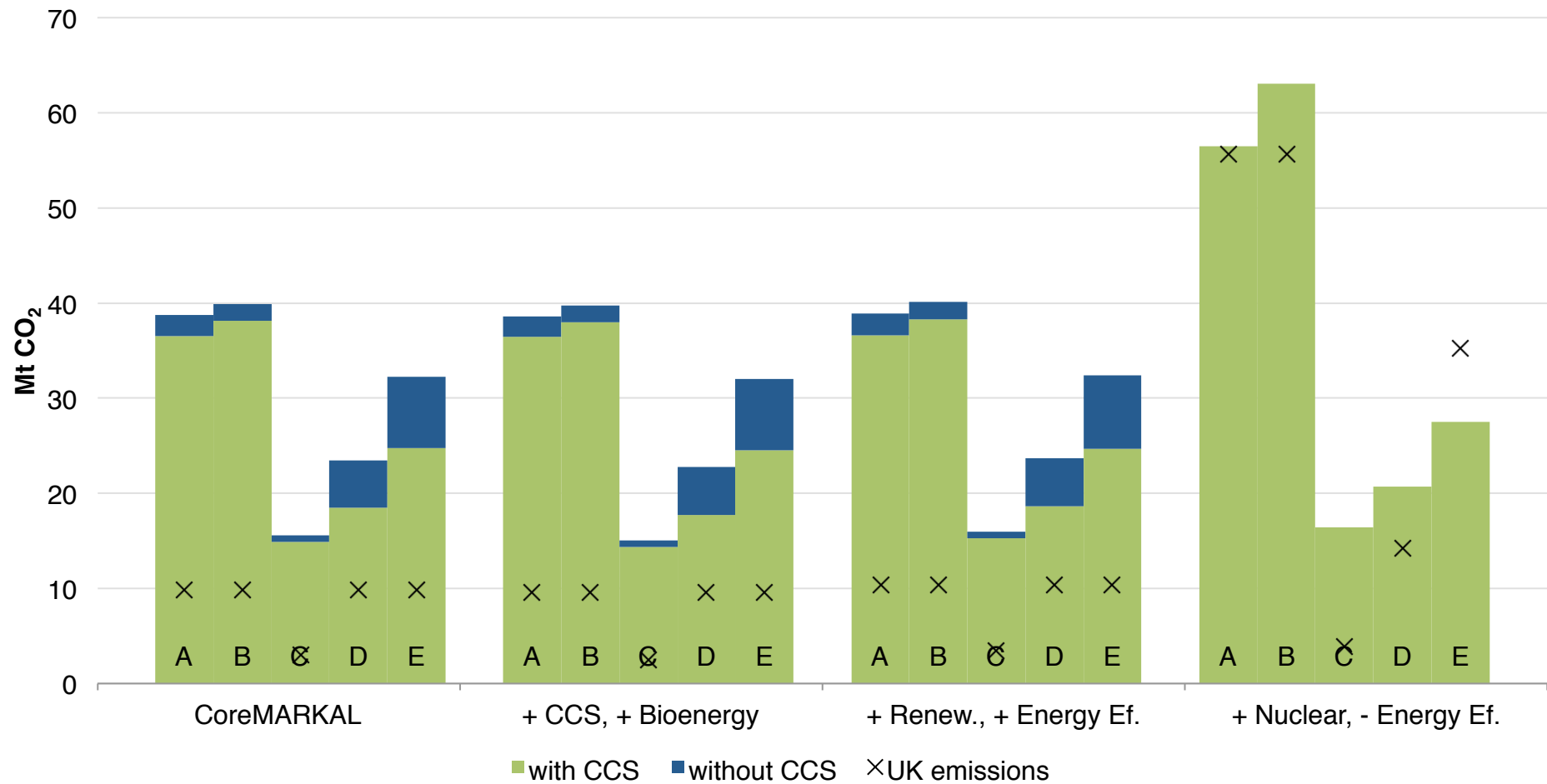
UK Steel scenarios / Energy pathways

	CoreMARKAL	High CCS, more bioenergy	High renewables, more energy efficiency	High nuclear, less energy efficiency
A: Current Scrap / BF – BOF	Total CO₂ emissions (in UK or other countries) required to supply UK steel demand in 2050, in terms of: • UK production / steel imports required; • Use of CCS in UK steel industry; • Levels of UK electricity decarbonisation; • Share of end-of-life scrap recycled; • Products' lifetime.			
B: BF – BOF				
C: 95% Scrap – EAF				
D: 75% Scrap / 25% DRI – EAF				
E: 50% Scrap / 50% DRI – EAF				

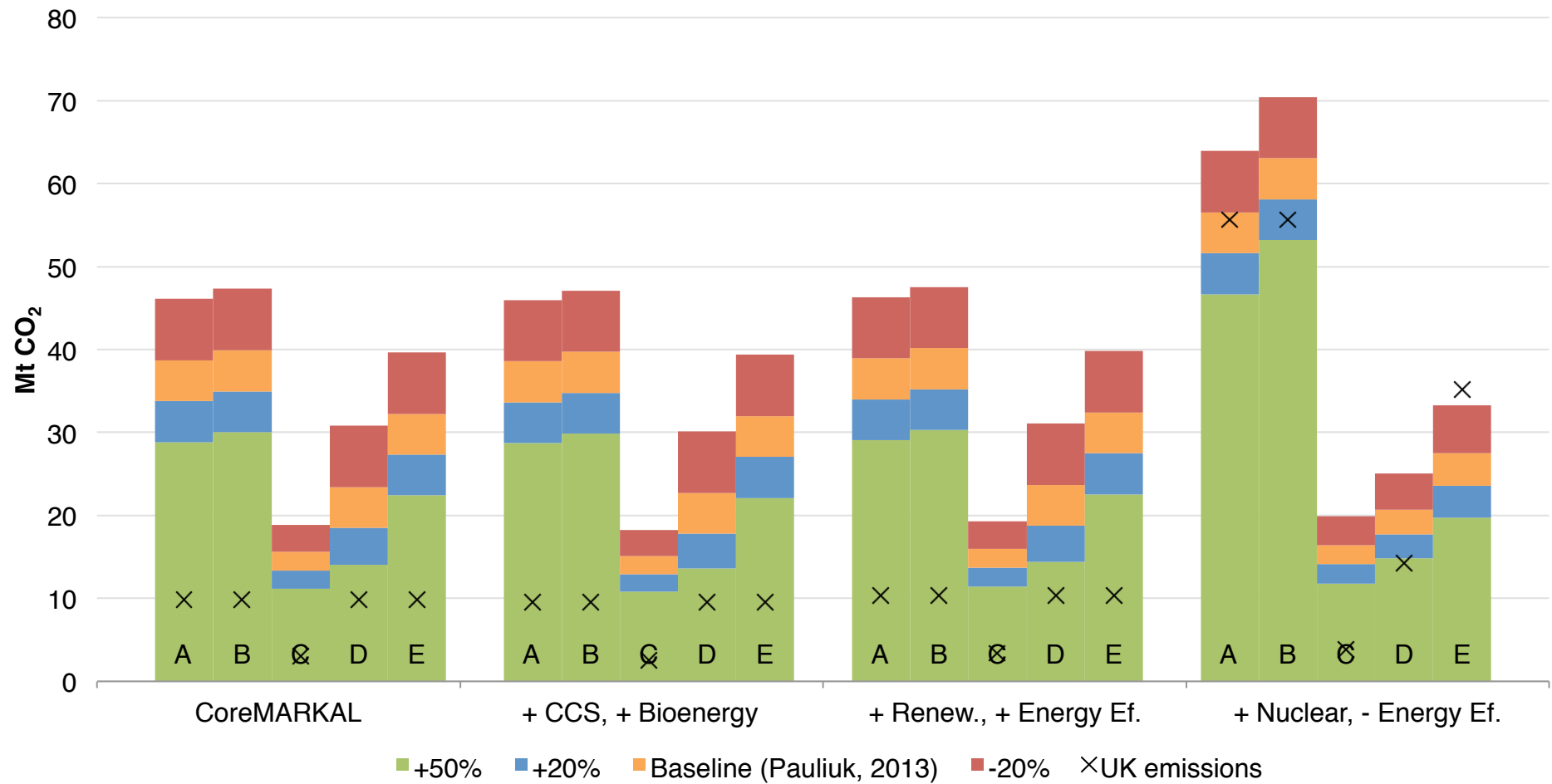
UK steel production / steel imports required



Use of CCS in the UK steel industry



Change in products' lifetime in the UK



Conclusions

Best solutions to **minimise global CO₂ emissions** caused by steel purchased in the UK and to **reduce dependence on imports**:

- Maximise domestic end-of-life scrap in UK steel production;
- Deployment of direct reduced iron – electric arc furnace route in the UK;
- Extending products' lifetime in the UK.

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