Steel and aluminium facts

The first page of the WellMet2050 report, *Conserving our metal energy*, is entitled: Must we melt our used metal. The page contains a number of general facts about steel and aluminium, which set the scene for the exploration of the re-use of metal without melting. The facts, calculations, assumptions and data sources are explained in this working paper. Many of the numbers presented in the report have been rounded from the original source data.

Steel

For consistency, data for steel is taken wherever possible from the World Steel Association or UK steel publications. Energy and CO_2 emission data are sourced from IEA publications.

STEEL	Units	Year	UK	World	Ref
Mass flows					
Crude production	Mt	2007		1,351	1, p7
	Mt	2008		1,327	1, p7
Mill products	Mt	2008	6.2		2, p11
Imported mill products	Mt	2008	6.9		2, p11
Imported in manufactured products	Mt	2008	11.3		2, p11
Total demand	Mt	2008	24.4		2, p11
Apparent supply of scrap	Mt	2008	9	445.2	1, p26
Energy and CO2 emissions					
Primary energy intensity, BF/BOF route	MJ/kg	2007		13–14	3, p484
Primary energy intensity, EAF route	MJ/kg	2007		4–6	3, p484
CO2 emissions intensity, BF/BOF route	$kgCO_2/kg$	2007		1.60	3, p484
CO2 emissions intensity, EAF route	$kgCO_2/kg$	2007		0.40	3, p484
CO2 emissions, steel total	$GtCO_2$	2006		2.5	4

- Hyde Park is 142 hectares or 1.42 million m^2. The UK collected 9 million tonnes of scrap steel[1] at an estimated average density of 1,200 kg/m^3 (based on minimum density thresholds for various steel scrap grades), which equates to 7.5 million m^3 of steel. This steel spread over the area of Hyde Park would give a height of 5.3m.
- The UK demand for steel (24.4 Mt) is 1.8% of the global steel production (1,327 Mt) in 2008.
- Global crude production reached an historic peak of 1,351Mt in 2007.
- In 2008, the amount of scrap used in steel making (445.2 Mt) made up 33.5% of the global crude production (1,327 Mt).
- using today's global average conditions, the primary energy requirement for steelmaking from scrap (Electric arc furnace, EAF = 5 MJ/kg) is about 1/3 of the primary energy required for steelmaking from ore (Blast furnance/basic oxygen furnace, BF/BOF route = 13.5 MJ/kg). Coke is

counted as a primary energy source, and electricity is counted as the fuel source, e.g. coal, gas or hydro. Any scrap melted in the BF/BOF route, or ore used in the EAF route, is ignored.

- using today's global average conditions, the CO_2 emissions for steelmaking from scrap (EAF route =0.40 $kgCO_2/kg$) is about 1/4 of the CO_2 emissions for steelmaking from iron ore (BF/BOF route = 1.60 $kgCO_2/kg$). Both process and energy based CO_2 emissions are counted.
- steel melts at 1425°C (1.5%C) to 1540°C (pure Fe) depending on the carbon content in the steel.
- CO_2 emissions released during steelmaking (2.5 $GtCO_2$) accounts for 9.3% of all global CO_2 emissions (27 $GtCO_2$). 445 Mt scrap is used for steelmaking, at 0.40 $kgCO_2/kg$, releasing 180 Mt CO_2, or 0.7% of total global emissions (27 $GtCO_2$).

Aluminium

Data for aluminium is taken from the International Aluminium Association. Energy and CO_2 emission data are sourced from International Energy Agency publications.

ALUMINIUM	Units	Year	World	Ref
Mass flows				
Crude production	Mt	2008	55.5	5, p7
Apparent supply of scrap	Mt	2008	17.8	5, p7
Energy and CO2 emissions				
Primary energy intensity, average	MJ/kg	2008	175	6, p208
CO2 emissions, average	$GtCO_2$	2006	0.2	4

- global production of crude aluminium in 2008 (55.5 Mt) was 24 times less than the production of crude steel in the same year (1,327 Mt). Note, aluminium making has an internal recycling loop of 20Mt which is normally not included production statistics, and has also been excluded here to be comparable with the steel.
- producing aluminium from scrap requires 20 times less primary energy than from ore[6 7], although some estimates are as low as 10 time less.
- CO_2 emissions released during aluminium production (0.2 $GtCO_2$) accounts for 0.7% of all global CO_2 emissions (27 $GtCO_2$).
- In 2008, the amount of recycled scrap used in aluminium production (17.8 Mt excluding internal scrap) was 32.1% of the global production (55.5 Mt).

Emissions targets

Allwood et al. (2010)[4] have created five material flow scenarios for 2050 and argue that:

- demand for steel and aluminium is anticipated to double at least by 2050, by which time global carbon emissions must be reduced by at least 50%.
- even with the application of all known and emerging efficiency measures, perfect recycling measures and the carbon sequestration for primary production, the carbon targets will not be met
- alternative strategies, particularly in the downstream steel and aluminium production chains, should be pursued, including: re-using metal without melting, material light-weighting, reduction of manufacturing scrap and longer-life products.

References

1. World Steel Association (2009) *World Steel in Figures*, Brussels.

2. UK Steel (2009) *Key Statistics 2009*, London.

3. International Energy Agency (2008) *Energy Technology Perspectives 2008*, Paris.

4. Allwood et al. (2010) *Options for achieving a 50% cut in industrial carbon emissions by 2050*, Environmental Science & Technology, 44:1888–1894.

5. International Aluminium Institute (2008) *Aluminium for Future Generations/2008*, London

6. International Energy Agency (2007) *Tracking Industrial Energy Efficiency and CO2 Emissions*, Paris

7. International Aluminium Institute (2009) *Aluminium for Future Generations*, London