
INTRODUCTION

LOW CARBON INNOVATIONS IRON/STEEL

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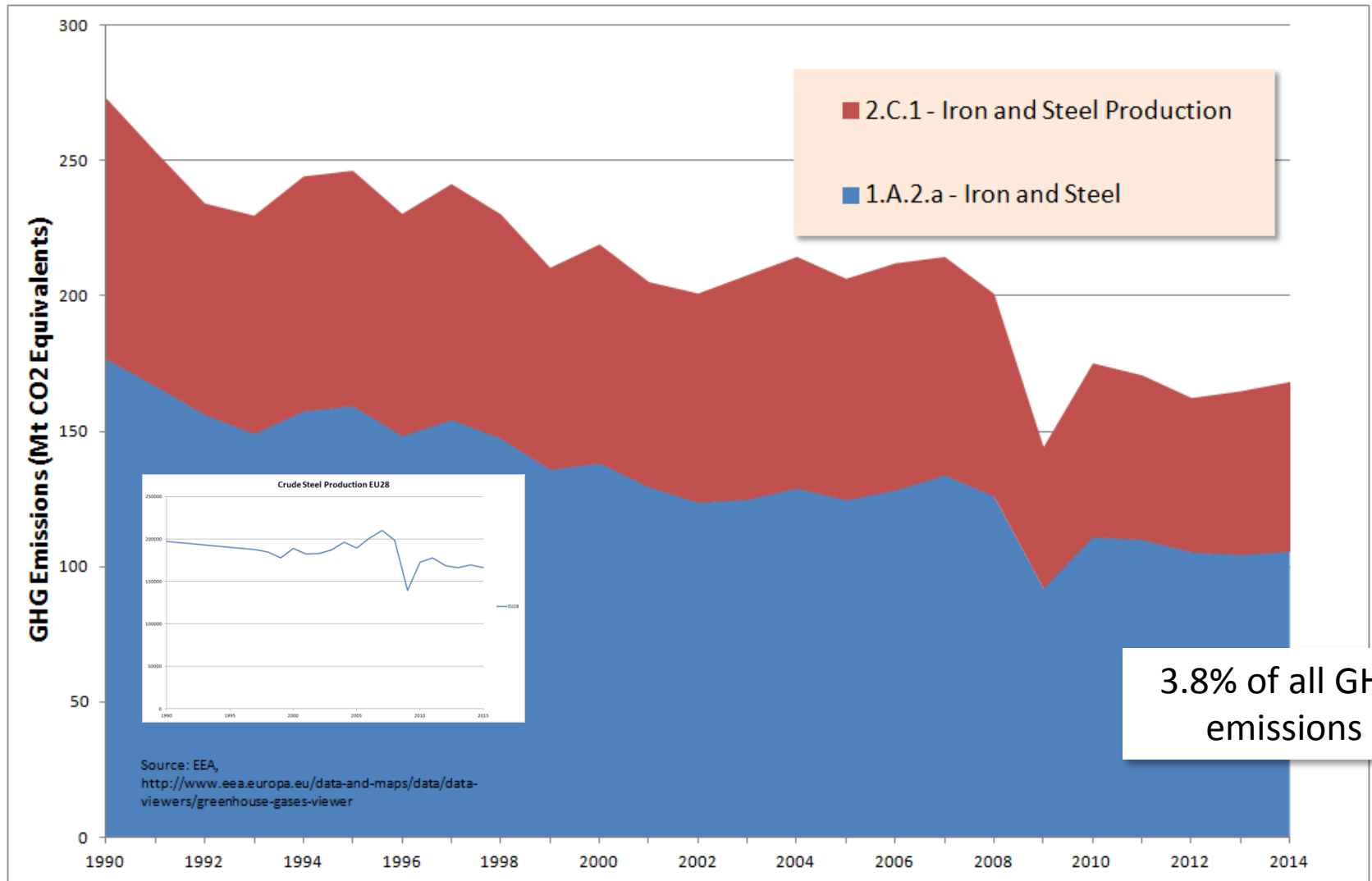
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Utrecht University (Netherlands)

Brussels, 17 February 2017

Greenhouse Gas Emissions of Iron/Steel 1990-2014 (EU28)

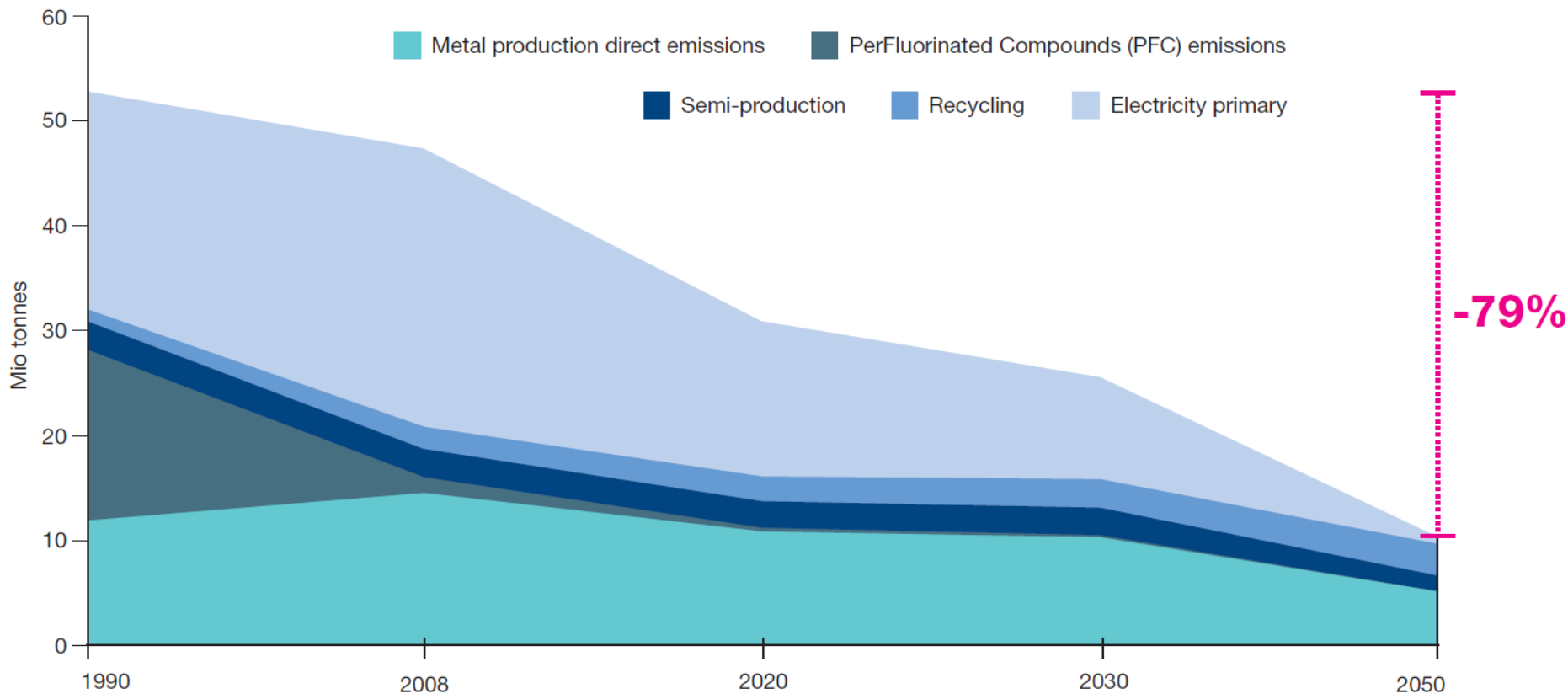


Mitigation options in basic materials industries

Clusters of mitigation options		Technology Readiness Level TRL
Materials industry	Integrated process improvement - Energy Efficiency (modernization and replacement) - Reduction in process-related emissions	
	Fuel switch - towards renewable energy sources (e.g. based on hydrogen) - towards decarbonized electricity (indirect emissions)	
	End-of-pipe (Carbon Capture and Storage CCS/ Carbon Capture and Use CCU)	
	Recycling and re-use (innovative recycling processes)	
downstream	Material efficiency (in production and downstream)	
	Material substitution (downstream)	

Decarbonisation Challenges are different across sectors

Total European Aluminium CO2 Equivalent Emissions Reduction



Source: European Aluminium Association: An aluminium 2050 roadmap to a low-carbon Europe

Innovative Iron/Steel Technologies

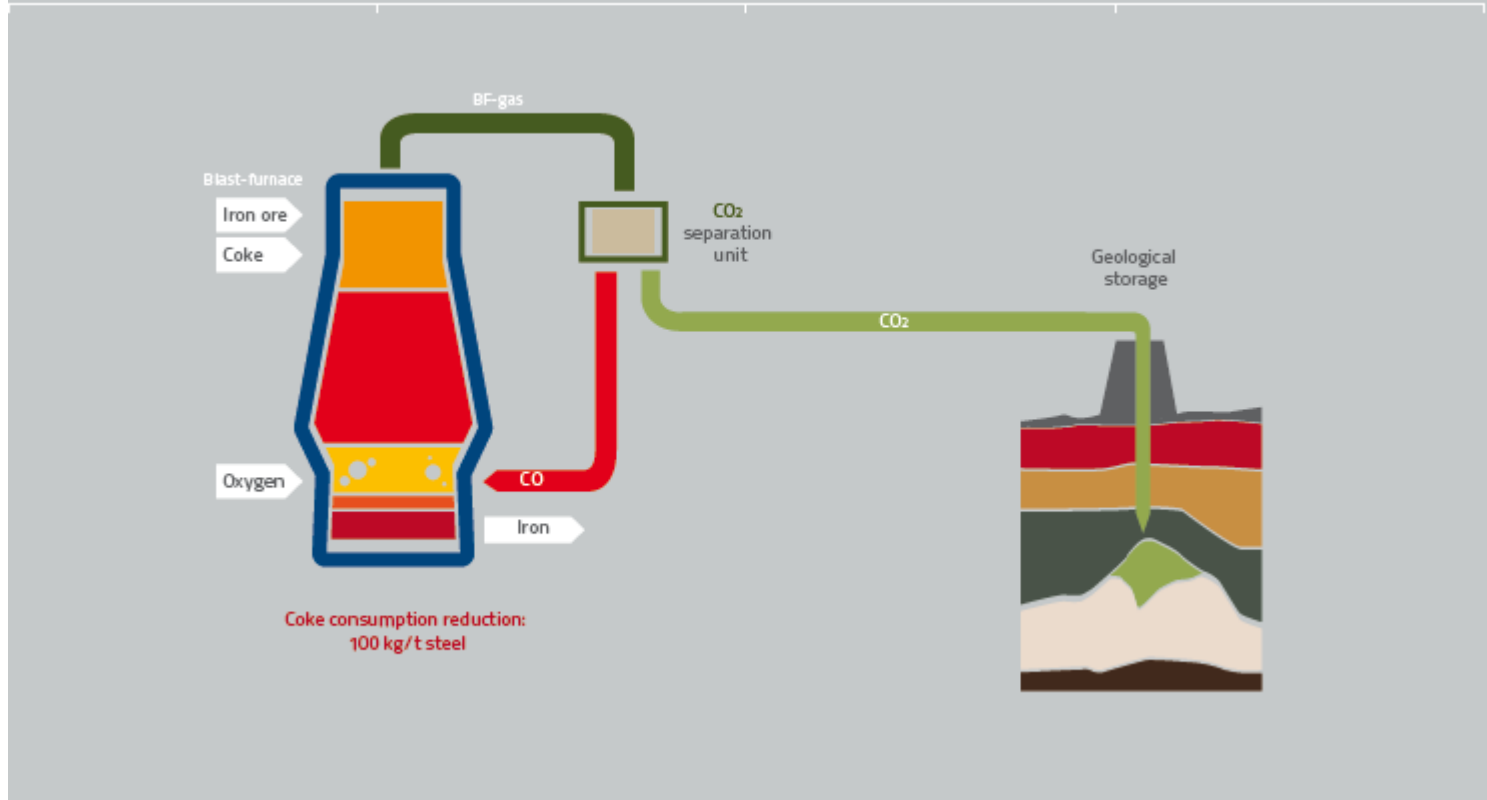
Roadmap ULCOS Technologies

ABATEMENT POTENTIALS OF THE ULCOS TECHNOLOGIES

Technology	Expected potentials for direct CO ₂ mitigation effects	Soonest expectations (from a purely technical perspective)
Top Gas Recycling Blast Furnace (ULCOS-BF)	15% without CCS 60% with CCS	Laboratory: done Pilot: done Demonstrator: tbc Deployment: > 2020 onwards
Bath smelting (Hisarna)	20% without CCS 80 % with CCS	Laboratory: done Pilot: 2011-2013 Demonstrator: 2020 Deployment: > 2030
Direct reduction (ULCORED)	5% without CCS 80% with CCS	Laboratory: done Pilot: 2013 Demonstrator: 2020 Deployment: > 2030
Electrolysis (ULCOWIN)	30% with today's electricity generation mix 98% with CO ₂ free electricity generation	Laboratory: ongoing Pilot: 2020 Demonstrator: 2030 Deployment: > 2040

ULCOS Blast Furnace (BF) Process with CCS

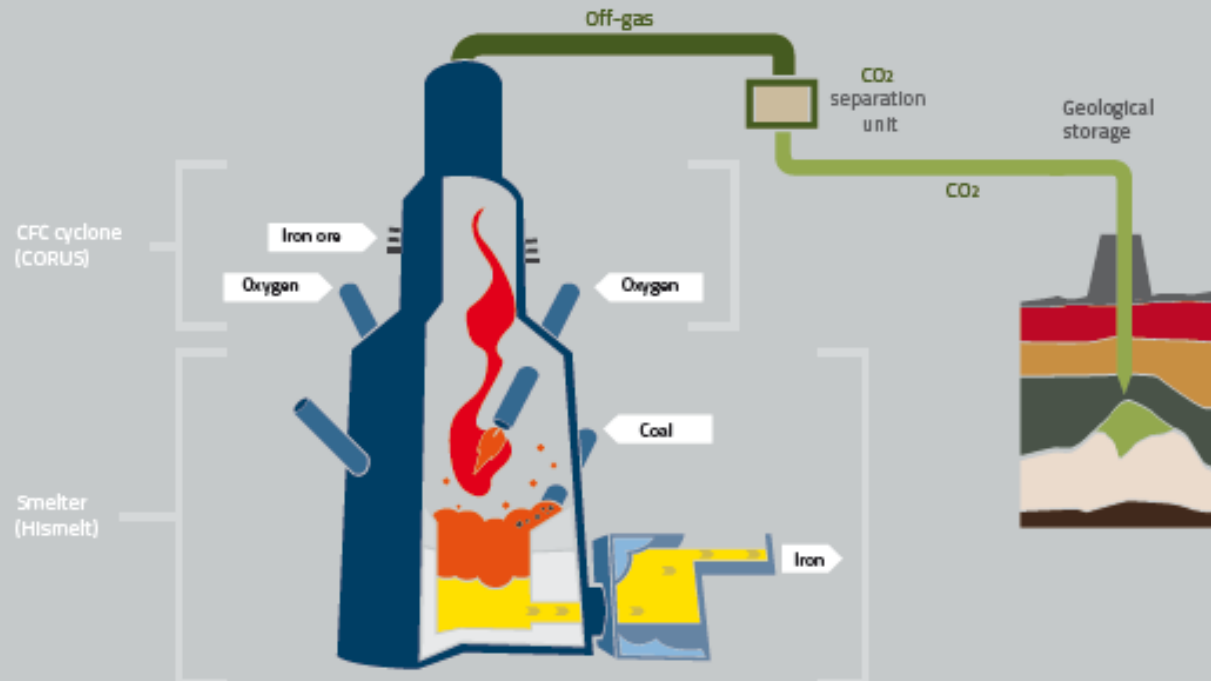
PRINCIPLE OF THE ULCOS-BF PROCESS



Source: Eurofer 2013, A steel roadmap for a low carbon Europe 2050

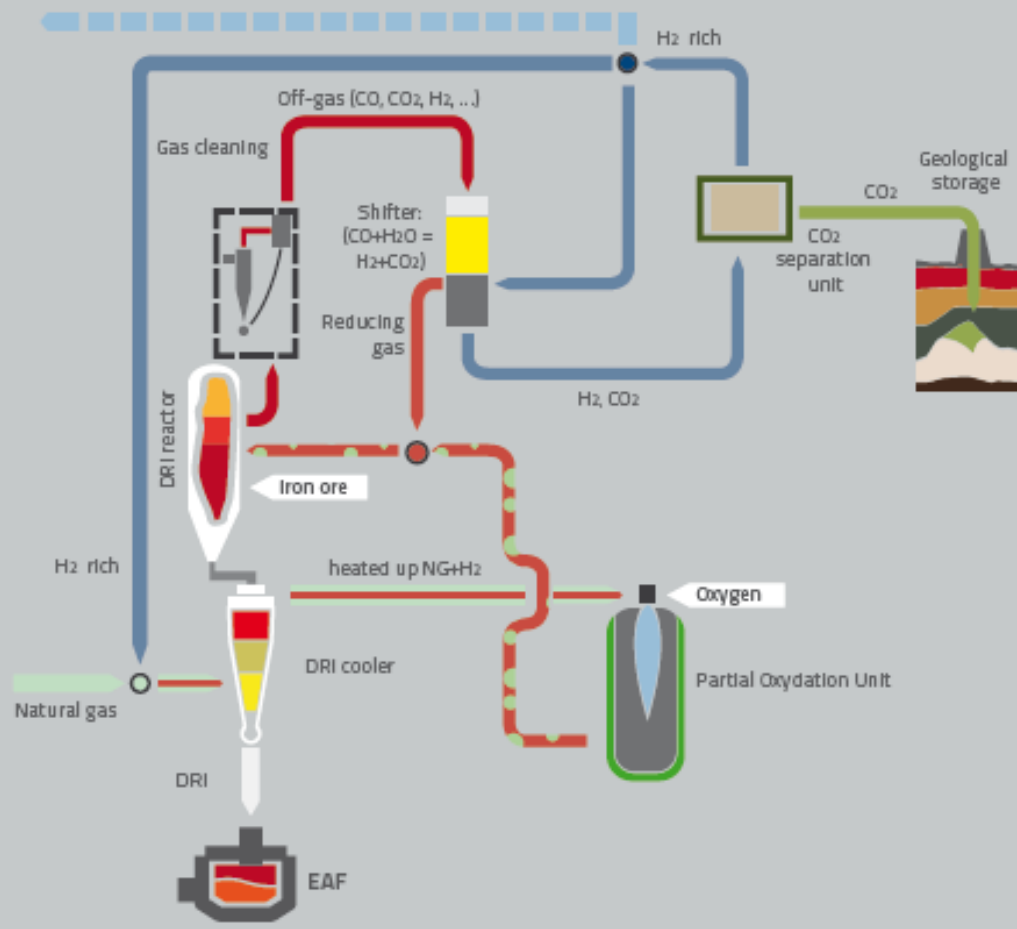
Hisarna Process: bath smelting reduction

PRINCIPLE OF THE HISARNA SMELTING REDUCTION PROCESS



ULCORED: natural gas based reduction

PRINCIPLE OF THE ULCORED PROCESS



Source: Eurofer 2013, A steel roadmap for a low carbon Europe 2050

Hydrogen-based Reduction of Iron Ores

'Hydrogen reduction of iron ore generates H_2O instead of CO_2 , leading to decrease in CO_2 emissions.

