Industry direct CO$_2$ emissions are one quarter of total EU emissions

60% of this is from four sectors:
- Iron and steel
- Chemical industry
- Petroleum refining
- Cement and lime

25% of industrial emissions are inherent to process chemistry of some key materials
- Steel – blast furnace, reduction of iron ore
- Cement – calcination, lime from limestone
- Hydrogen – steam reforming, for fuel upgrading, methanol and ammonia/fertiliser production

IPPC targets for industry emission reductions in EU
- 34-40% by 2030
- 83-87% by 2050

CCS necessary to make deep cuts in industry emissions

CCS for high-emission processes could achieve 200-300 Mt/yr CO$_2$ reduction
- Processes listed above plus:
- Fluid catalytic cracking – catalyst regeneration
- Steam cracking for olefin production

Energy intensive industries in Europe contribute significantly to GDP, employment and innovation
- Iron and steel, cement, refineries, chemicals combined have turnover of €900 billion, c.7% of EU GDP, 25% of EU industry
- These sectors employ directly 1.75 million, 0.7% of EU labour force, 2.9% of EU industry employment
- Materials and innovations skills from these industries needed to grow green economy

Identified options for CCS from large industrial sources could contribute most of reductions required by 2030

Needs concerted action now to achieve this

But CCS from these large sources alone not sufficient for 2050 target, even at high-end estimates
• CCS is a key technology to achieve deep cuts in emissions from industry
• Fundamental industrial processes have inherent CO₂ formation where capture is only option for avoiding emissions

• Industry with high emissions clustered in several areas in Europe
• Storage sites identified in feasibility studies
• NW Europe clusters match well with storage availability in North Sea

Distribution in Europe of refineries, integrated steel plants, cement plants emitting >0.5 Mt/yr CO₂

![Map of Europe showing the distribution of industrial sources emitting CO₂.](image)

Key: • refineries, • integrated steel plants, ★ cement plant
Mid grey: regions with large industry sources totalling >5 Mt/yr,
Dark grey: regions totalling >10 Mt/yr,
Pecked lines: potential capture clusters.
Adapted from: Rootzén, et al, Management of Environmental Quality, 22, (1), 2011

CO₂ storage sites and volumes around Europe

![Map of Europe showing CO₂ storage sites and volumes.](image)

CO₂ from ammonia production

• 6-7 Mt/yr CO₂ already separated at ammonia plants and available for use
  – Figures adjusted for estimated bulk CO₂ sales and consumption in urea
• Most close to North Sea coasts
  ➢ Could be used to prove CO₂ transport and storage infrastructure

![Map of ammonia production in Europe.](image)

Key: yellow circle - ammonia plant; green flag - excess CO₂ available; red flag - CO₂ unlikely to be available.
Source: SCCS analysis, 2013

• CCS from large industrial sources can play major role in achieving 2030 emission reduction targets
• Appropriate policies and support mechanisms needed to achieve rate of deployment required
• Need wider measures to achieve 2050 targets
  – Efficiency improvements, fuel switching, CCS in wider and smaller applications

![Map of CO₂ capture clusters in Europe.](image)