Decarbonising Europe’s Energy Intensive Industries

The Final Frontier
Goal of Report

Findings: Chemicals

Findings: Steel

Findings: Cement

Role of public policy - EU ETS innovation fund

Conclusion
Goal of the report
Key considerations in “Final Frontier” report

• Identify options for deep GHG emission reductions in energy intensive industries (e.g. 80-95% ref. 1990)
• Look at process, product and business model innovation
• Take economic context of industries into account
• Solutions must be able to enhance competitiveness
• Focus on 3 sectors (chemicals, steel, cement = bulk of industrial GHG emissions)
• Identify role of public sector
• Design options for EU ETS innovation fund
Decarbonising the European economy

Reference Scenario

Reduction Scenario

-40%

-80%

-95%
Industrial decarbonisation

Industrielle Decarbonisierung

EU ETS Innovation Fund

Develop, Pilot & Demo

~1-2 investment cycles

Industrial pathway source: EC 2011

100% 80% 60% 13%
Chemicals Industry
EU Chemical industry: status

Emissions from EU Chemical industry

Energy intensity in EU Chemicals production

Emissions from EU Nitric Acid Production

Emissions from EU Adipic Acid Production
**EU Petrochemicals outlook: from fossil fuel-based to bio-based**

- €3.7 billion investments in bio-based innovation from 2014-2020
- Deliver bio-based products that are comparable and/or superior to fossil-based products in terms of price, performance, availability and environmental benefits.
- on average reduce CO2 emissions by at least 50% compared to their fossil alternatives.

- Sufficient biomass-waste in EU to cover petrochemicals
- higher value added compared to biofuels, biomass power
- Supply chains to be developed
- Downstream product standards (market creation)
Elektric Vehicles (EV) cost-competitive by 2025
41 million EVs sold per year by 2040
Impact = 13 million bbl less crude per day demand (= daily Saudi production!)
i.e. more than daily EU refining throughput...
Refining and petrochemicals are strongly connected (in the EU)
Ergo: disruption very likely over next decades
Refining Bio-based Chemistry
Antwerp Harbour 2035-2050
(bron: Google-maps)

Refining Petrochemistry
Antwerp Harbour 2016
(bron: Google-maps)

... a possible future
 Incremental technology improvements are possible but not enough to bring about -80 to 95%
Electrochemical Ammonia production

The past: Hydrogen electrolysis
The future: Solid State Synthesis

- Possible breakthrough: CO2 free ammonia with Solid State Synthesis
- Ammonia can be used as energy storage (e.g. battery with RES)

Vermork plant, Riukan (Norway) 1911

Source: http://www.frontiersin.org
Business model transformation for fertiliser industry

Can reduce (global) demand for fertilisers and ammonia by more than 50%

Source: knowledge4food.net and dronelife.com
Steel Industry
Steel industry: Status

Declining production (capacity) & over-capacity
Steel industry: Process Innovation

Source: Tata Steel
Steel industry: Product Innovation

New product technologies (e.g. nano-tech., rare-earth) to tap into new markets.

lighter, stronger, ... steel

Source: Nanosteel

Source: Tesla, Chevrolet
Steel industry: Business Model Innovation

- EU exports 16 million tonnes scrap-steel!
- Re-use/up-cycle scrap via Electric Arc Furnace (EAF) steel production
- less CO2, less energy, less costs, …
- Option to replace Blast Furnace surplus with (limited) EAF production
- Indirect EU ETS costs can be issue here…
Cement Industry
Cement industry: Status

- Declining production & over-capacity
- Still (limited) inefficient production in EU
- Important to modernise and rationalise cement production —> more resilience against e.g. carbon leakage
Cement industry: Process Innovation

- Calcium looping CO2 capture
- Ideal for cement production!
- Can reduce energy costs
- Tested now in Taiwan
- up to 85% CO2 capture
- Even better when combined at e.g. steel production site (joint CO2 capture)

- Lime production via electrolysis
- Lab scale tested
- CO2 further reduced to CO or C
Cement industry: Clinker substitution

- New clinker replacements needed
- Aether® cement: 30% less CO2 per tonne clinker
- Plasmarok® from enhanced landfill mining. Can reduce EU cement emissions up to 11%
Cement industry: Downstream (product) innovation

- Less but better concrete
- Smart application of concrete

Exciting innovations!

Nano-technology

3D-printing
Role of public policy
EU ETS innovation fund
Role of public policy

- Form long-term, cohesive vision on competitive future of EU energy intensive industries (incl. their decarbonisation)
- Support modernisation + rationalisation in case of production over-capacity
- Support pilot - demo of promising new process technologies (capital intense + project risk mitigation)
- Use public procurement & product standards to create/enable markets for low-carbon products
EU ETS innovation fund design

• Technology achievement parameters for access to fund (e.g. 20-25% CO2 ref. BAT or 20% lower LCOE for RES)

• Performance Milestone based reward enablers

• Financing mechanisms portfolio (e.g. grants in case of high project risks, loans/loan guarantees in case of capital liquidity or capital cost constraints)

• Lean but high quality governance of Fund

• Public procurement option for Member State co-financing (e.g. low-carbon steel, cement in infrastructure procurement)

• Fast-track state aid approval for Member State co-financing (under pre-determined conditions)
“The EU finds itself at an important moment in the history of its industrial development.

Ongoing and future process, product and business model innovations, will make deep emission reductions possible over the next decades.

But public policy needs to play a catalysing role.”