

Decarbonising Europe's Energy Intensive Industries

The Final Frontier



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Tomas Wyns - LCS-RNet Wuppertal 6 September 2016

Goal of Report

Findings: Chemicals

Findings: Steel

Findings: Cement

Role of public policy - EU ETS innovation fund

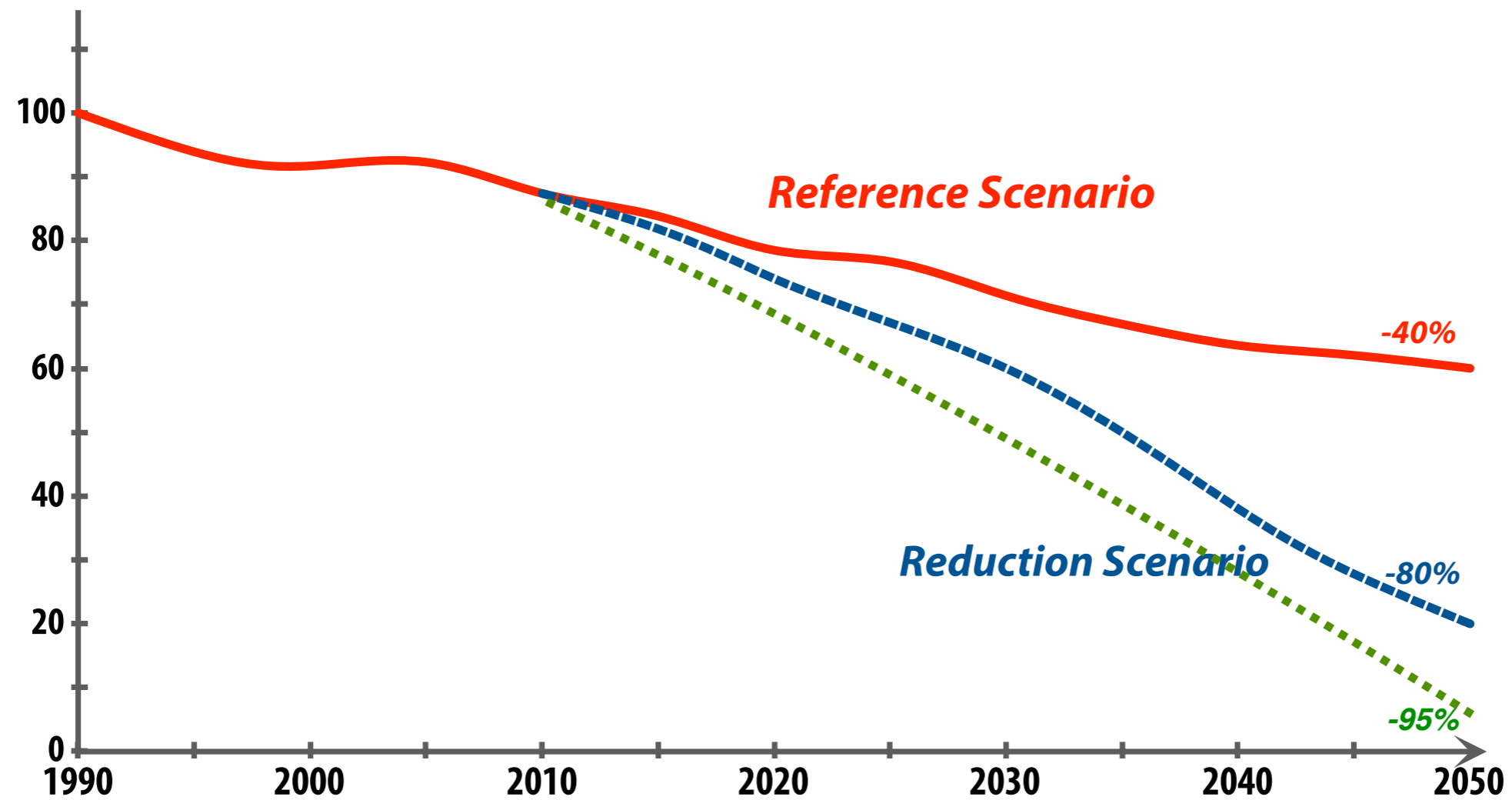
Conclusion

Goal of the report

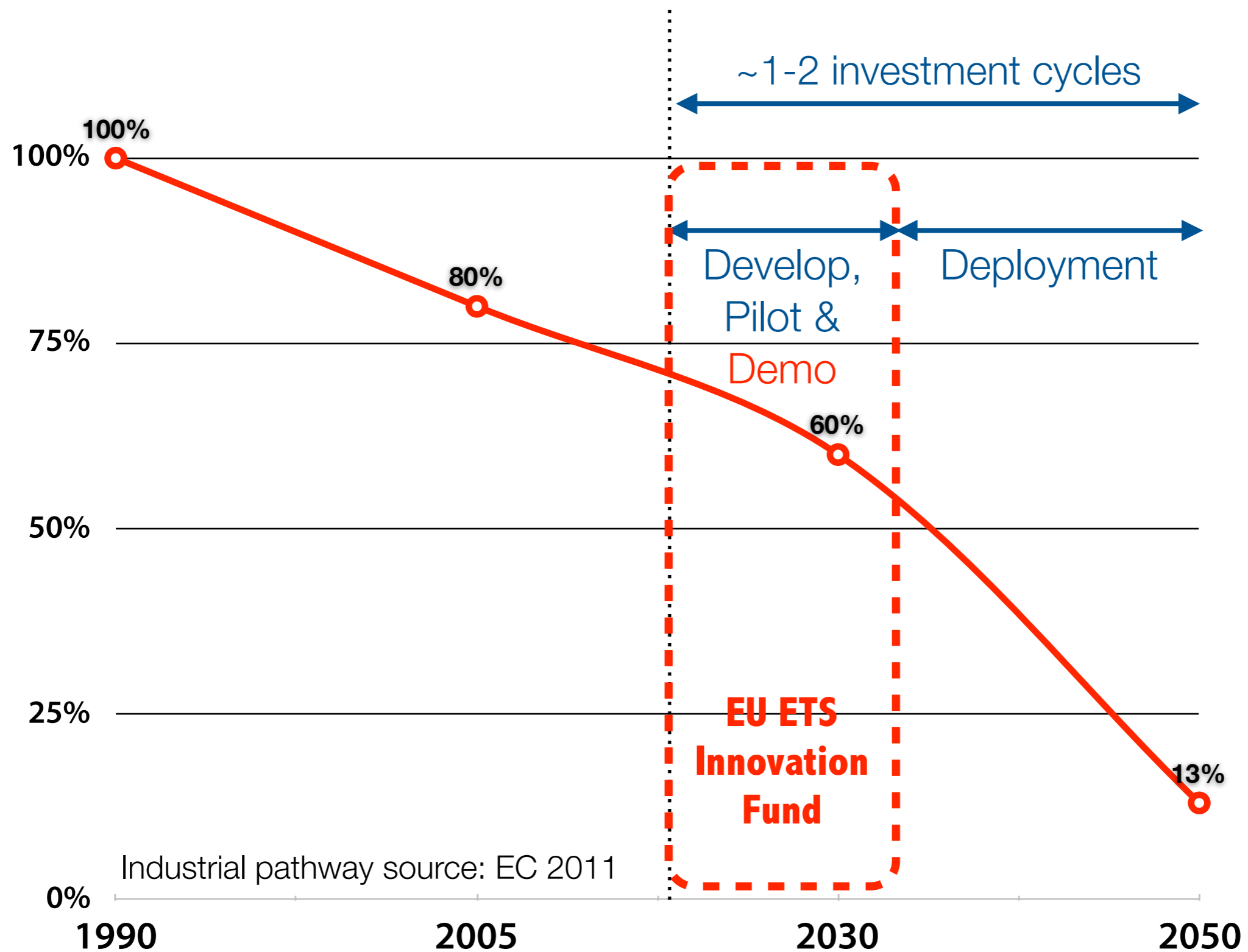
Key considerations in “Final Frontier” report

- **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



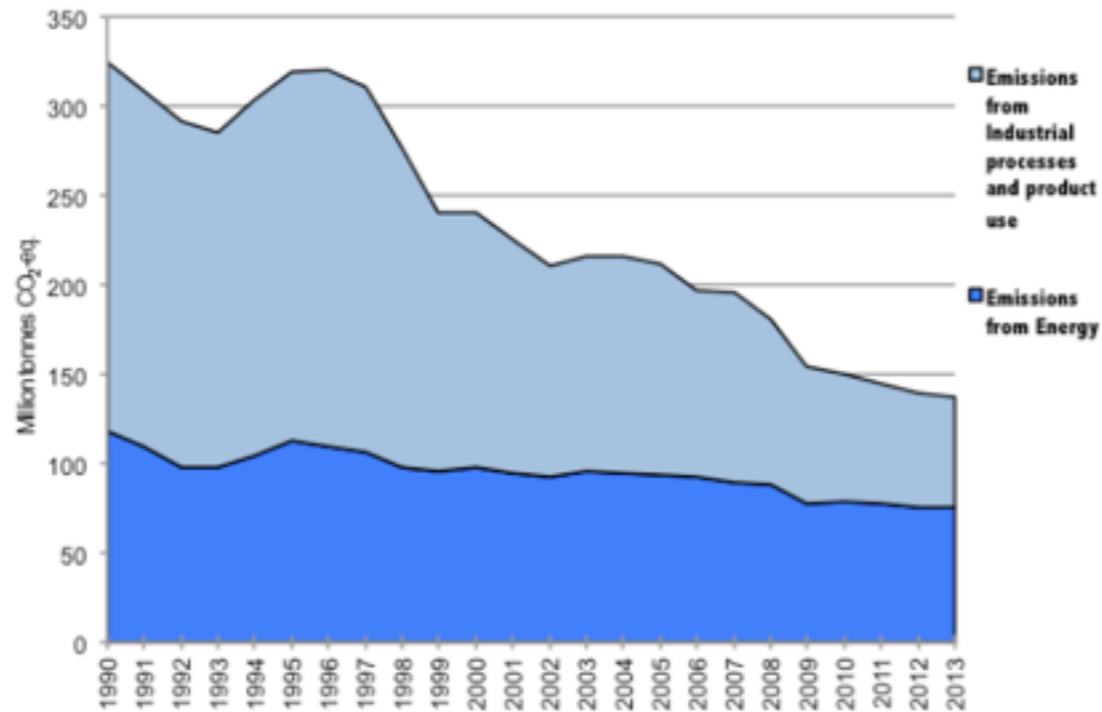
Industrial decarbonisation



Chemicals Industry

EU Chemical industry: status

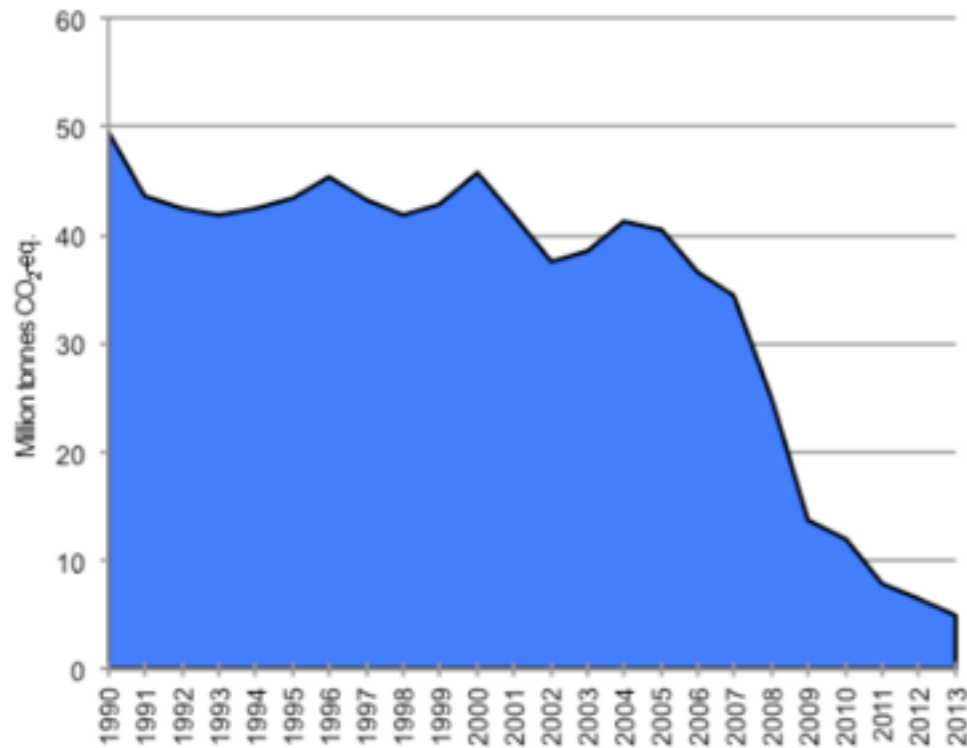
Emissions from EU Chemical industry



Energy intensity in EU Chemicals production



Emissions from EU Nitric Acid Production

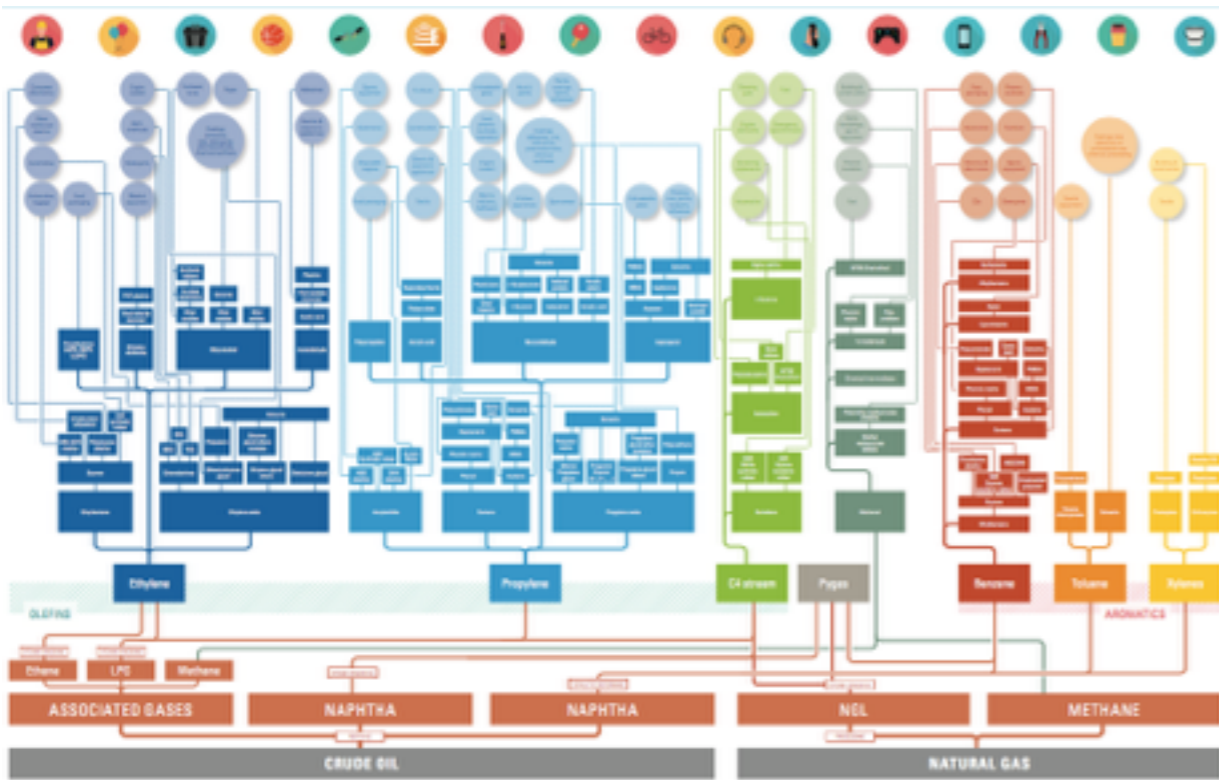


Emissions from EU Adipic Acid Production

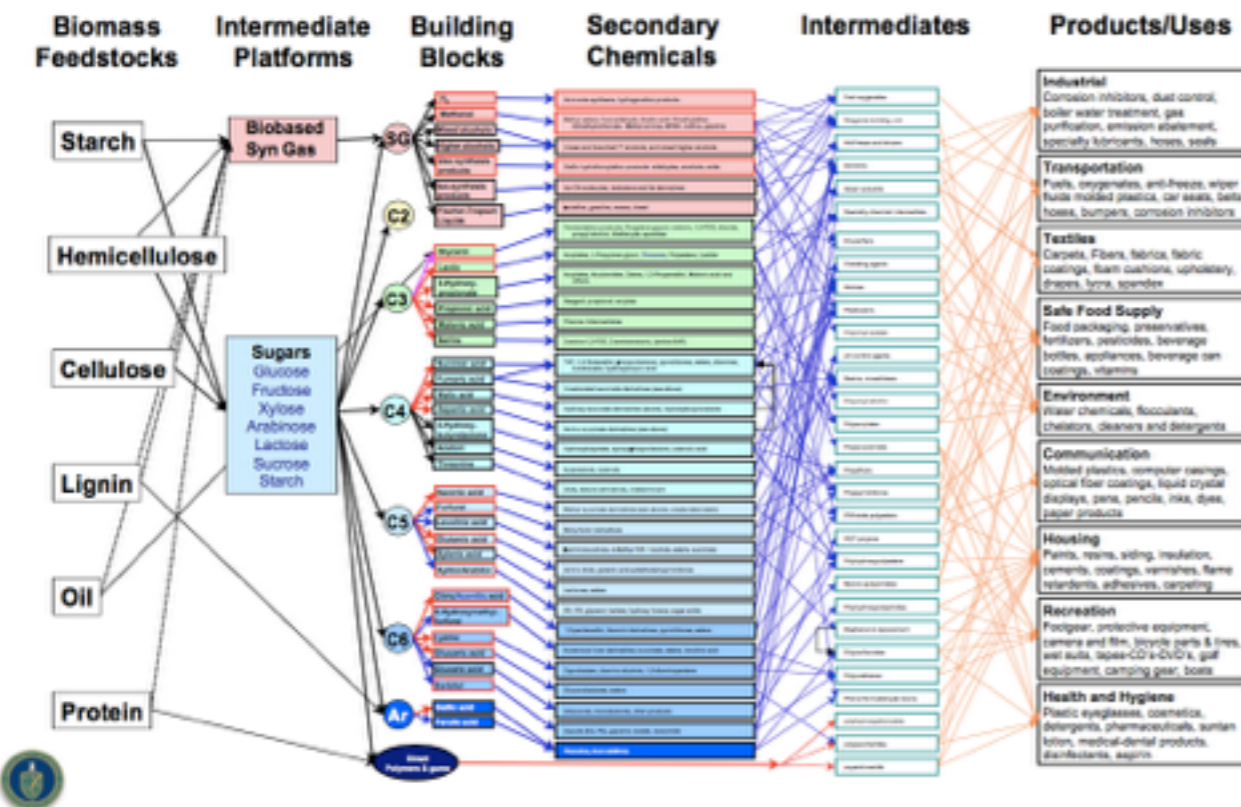


EU Petrochemicals outlook: from fossil fuel-based to bio-based

Petrochemicals



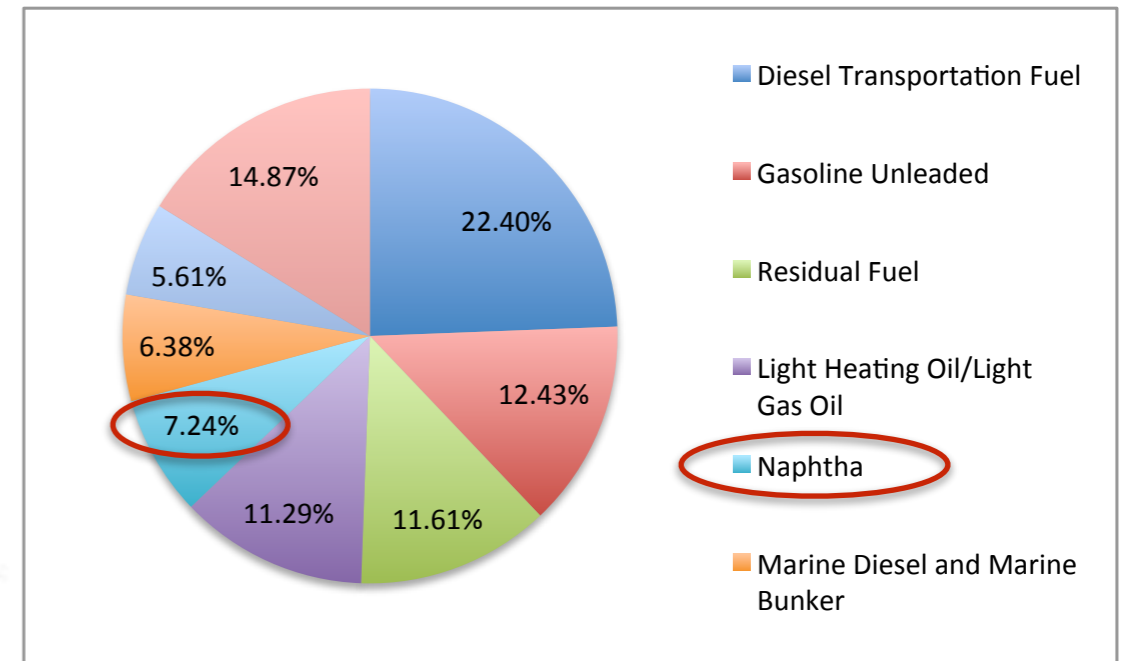
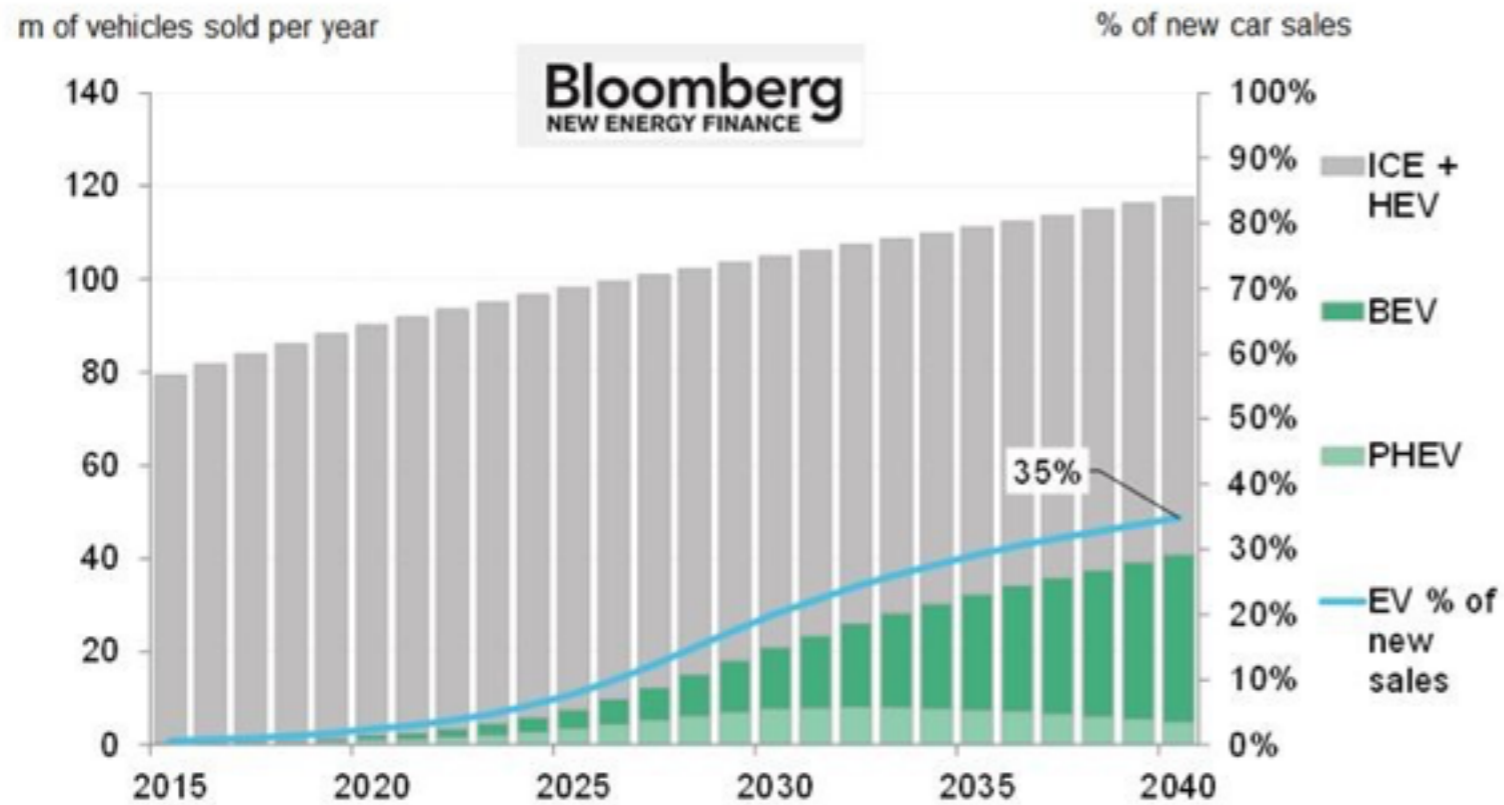
Bio-based chemicals



- €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)**

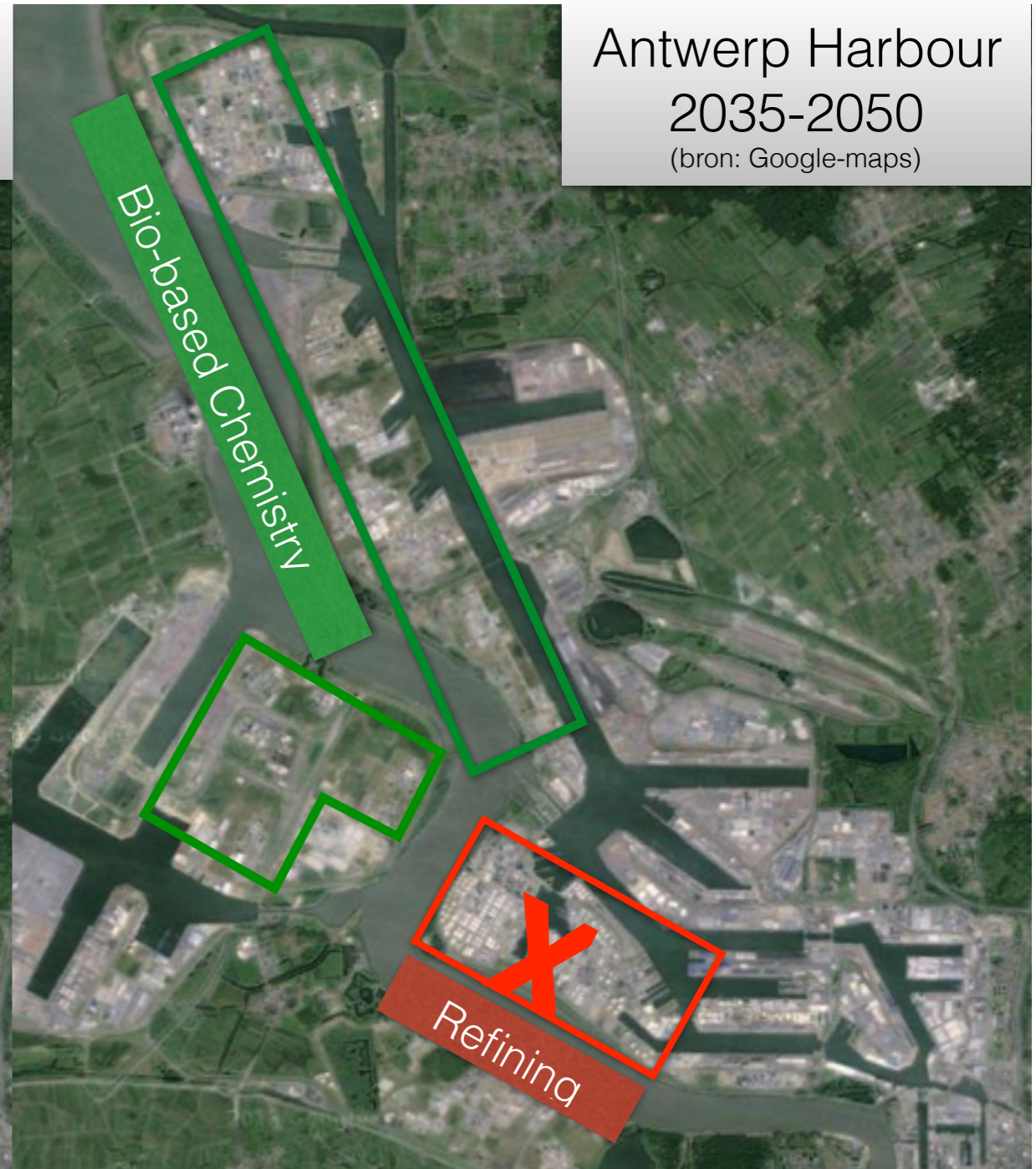
Petrochemicals must prepared for future feedstock-shock



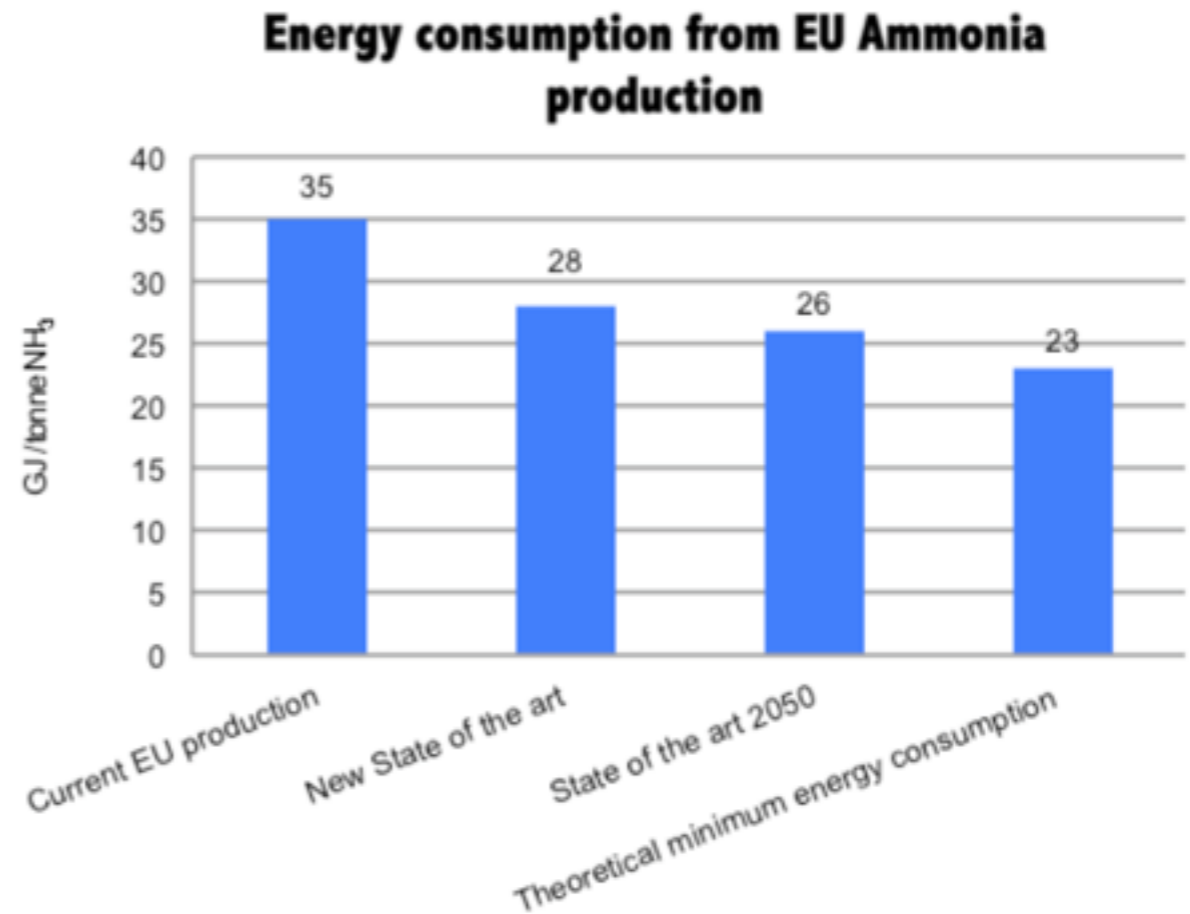
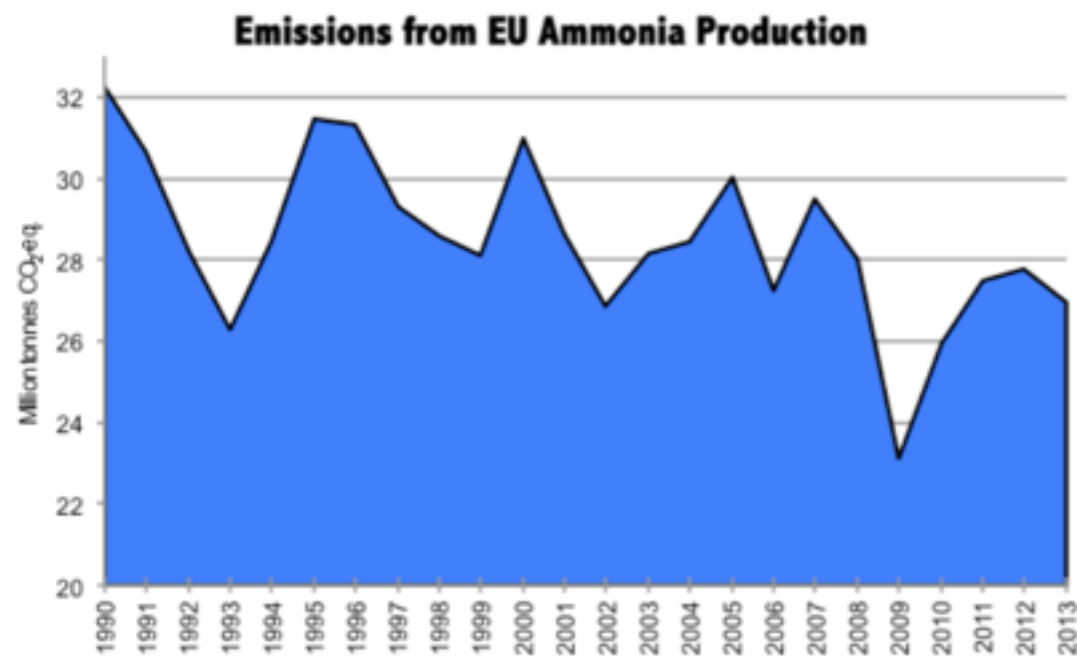
Benelux refining output (%)

- 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

... a possible future

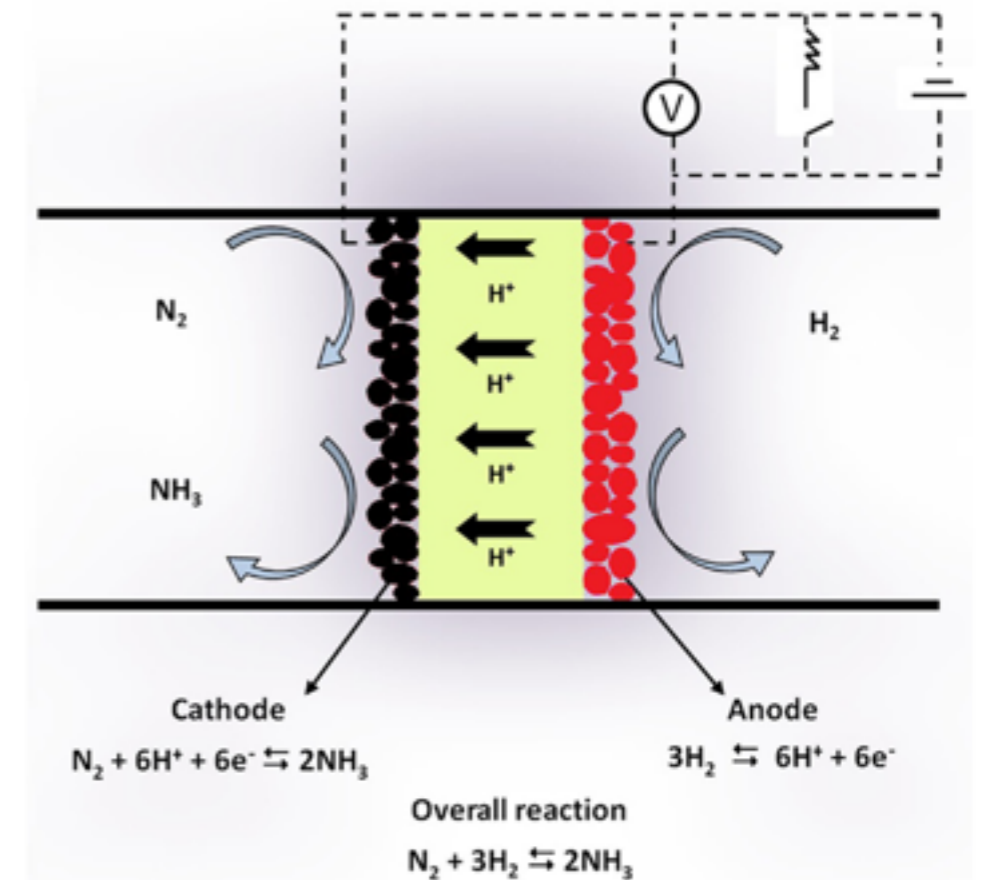


Ammonia for Fertiliser production



Incremental technology improvements are possible but not enough to bring about -80 to 95%

Electrochemical Ammonia production

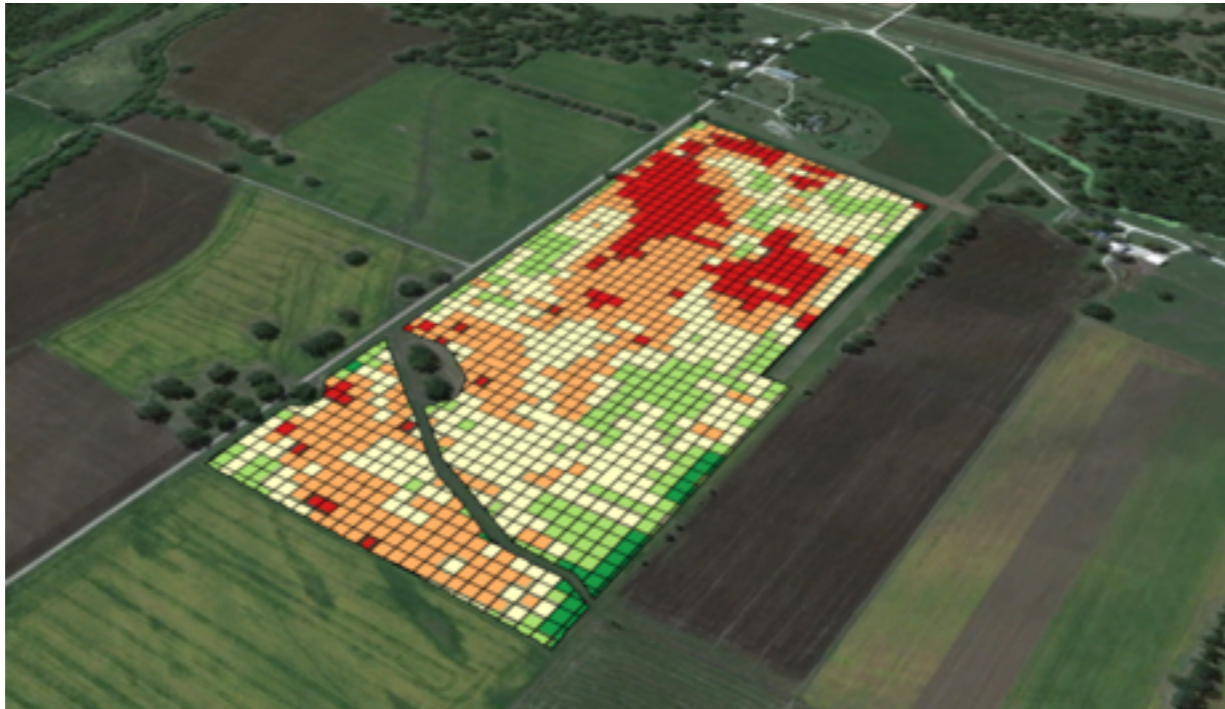


Source: <http://www.frontiersin.org>

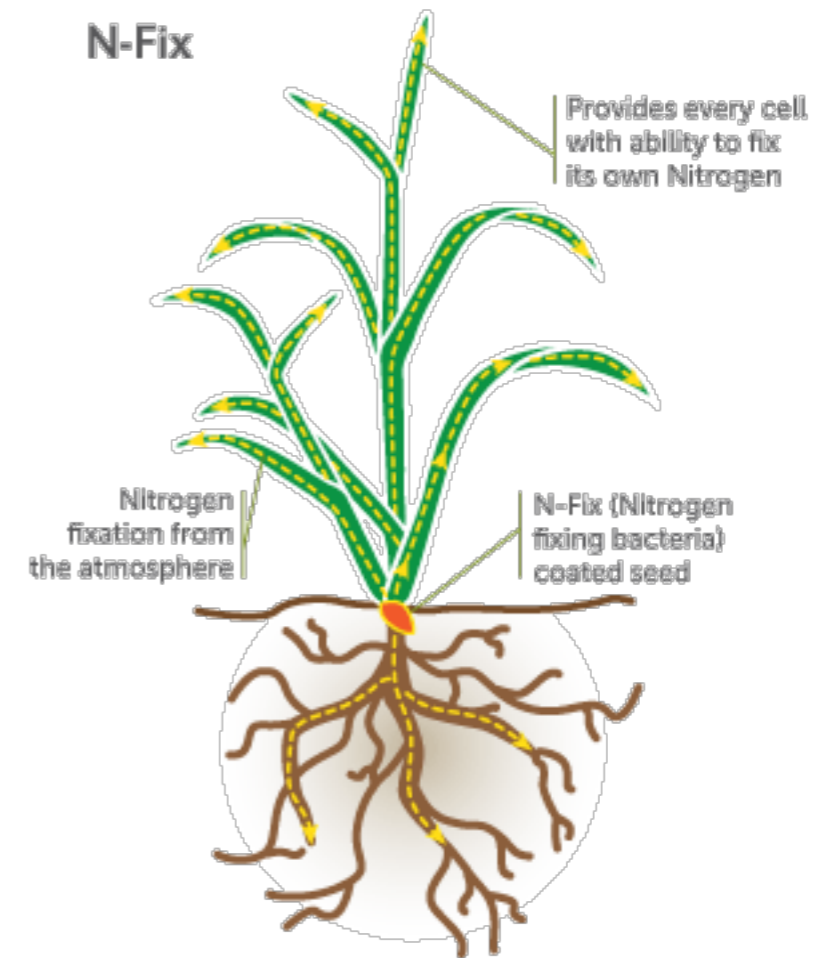
The past: Hydrogen electrolysis The future: Solid State Synthesis

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

Business model transformation for fertiliser industry



Source:
knowledge4food.net and
dronelife.com



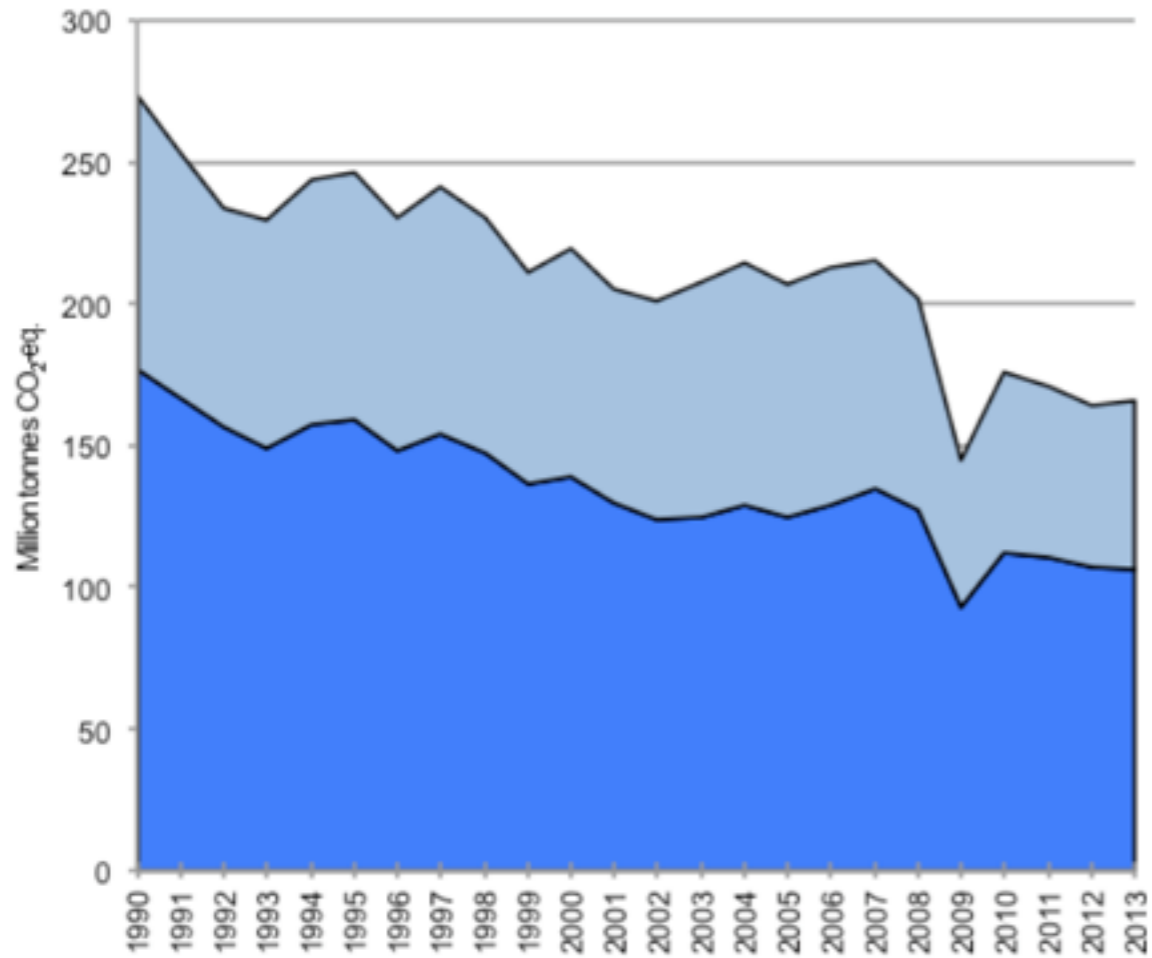
Source: Azotic-technologies

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

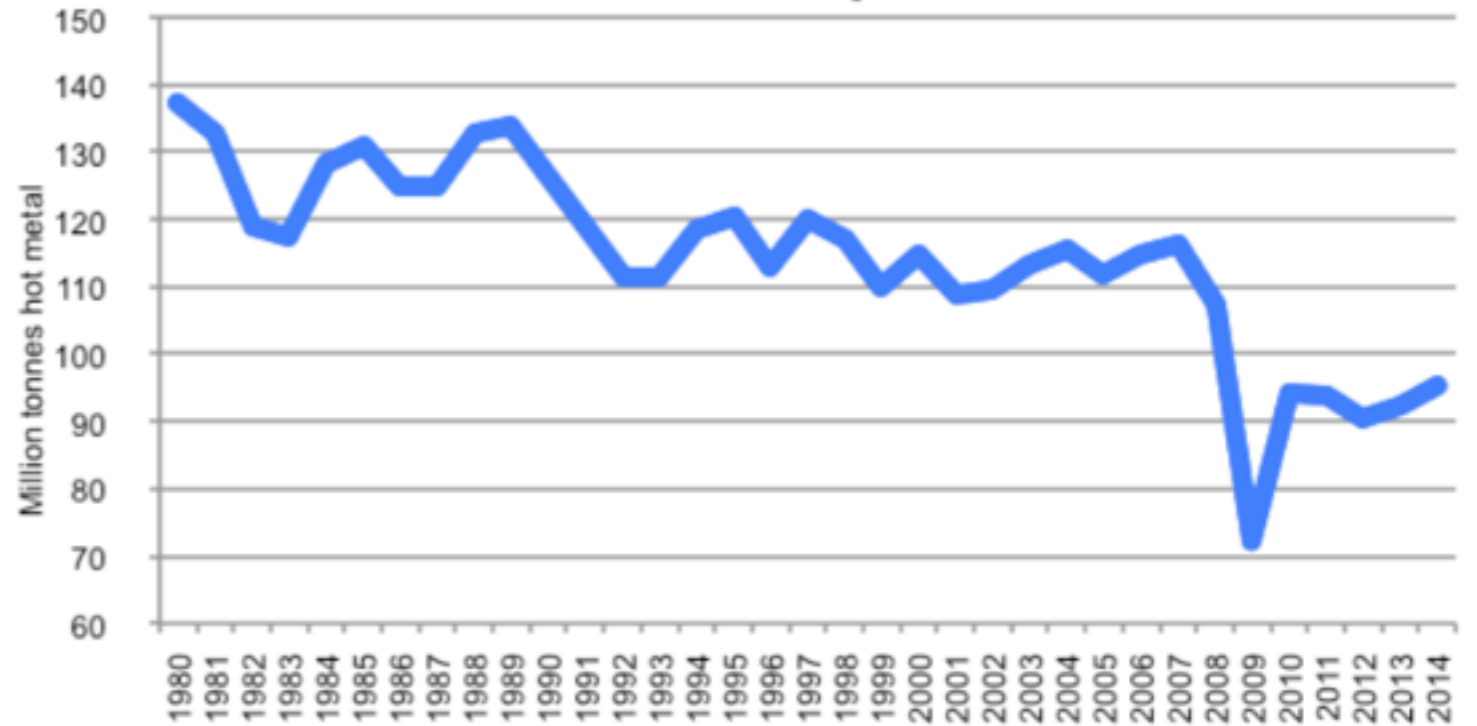
Steel Industry

Steel industry: Status

Emissions from EU Steel industry



EU Blast furnace iron production

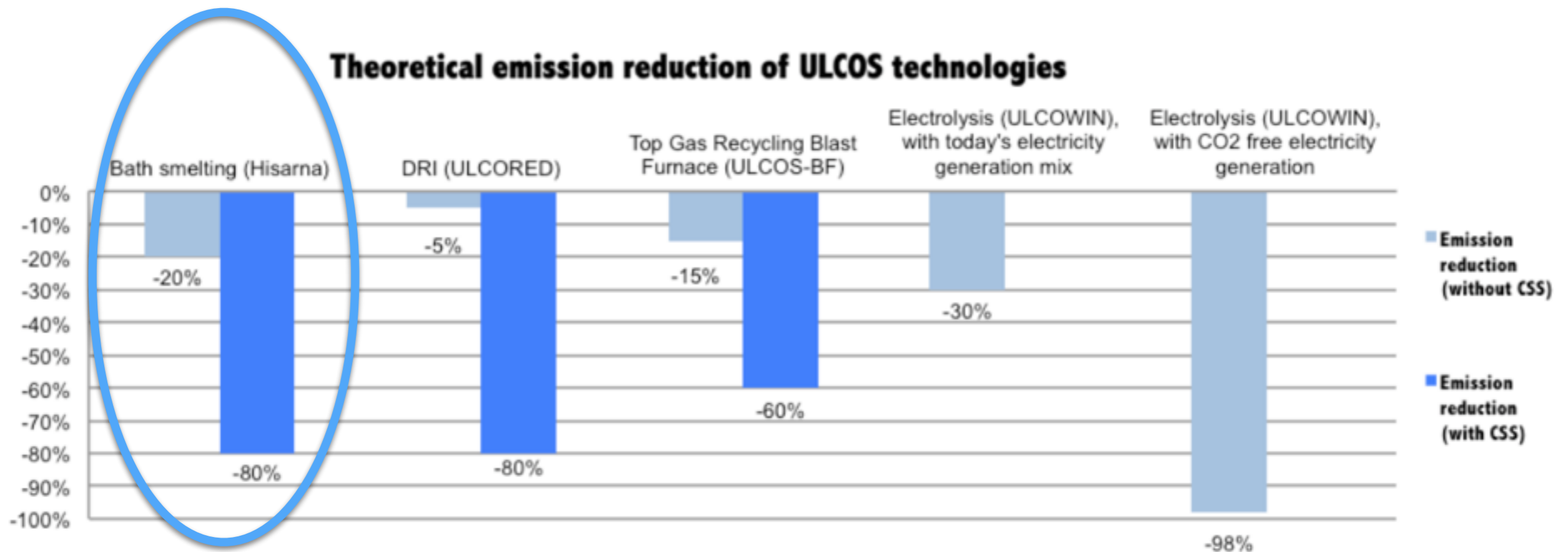


Declining production (capacity) & over-capacity

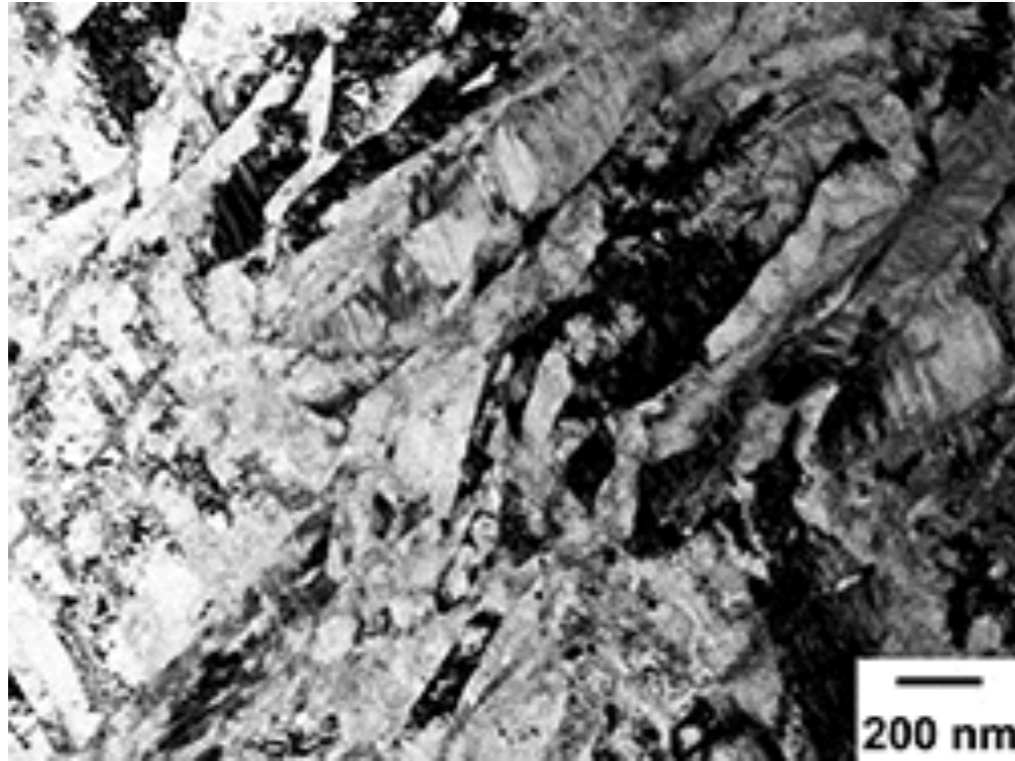
Steel industry: Process Innovation



Source: Tata Steel



Steel industry: Product Innovation



Source: Nanosteel

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

lighter, stronger, ... steel

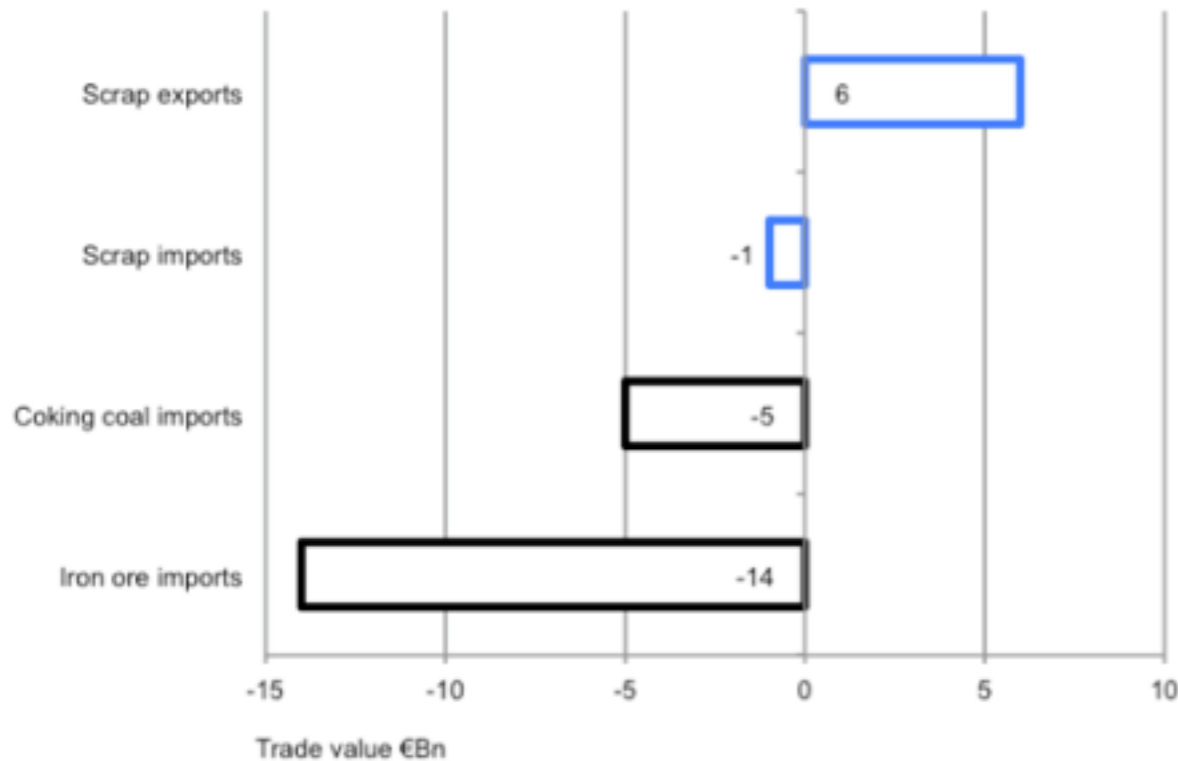


Source: Tesla, Chevrolet

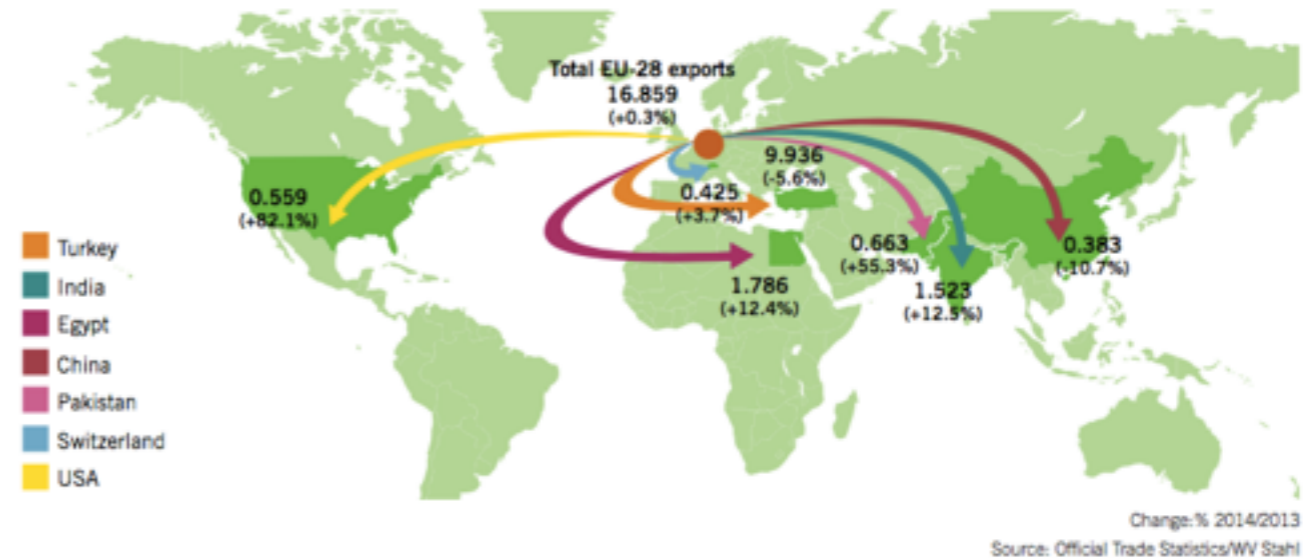
Steel industry: Business Model Innovation

EU Trade 2012

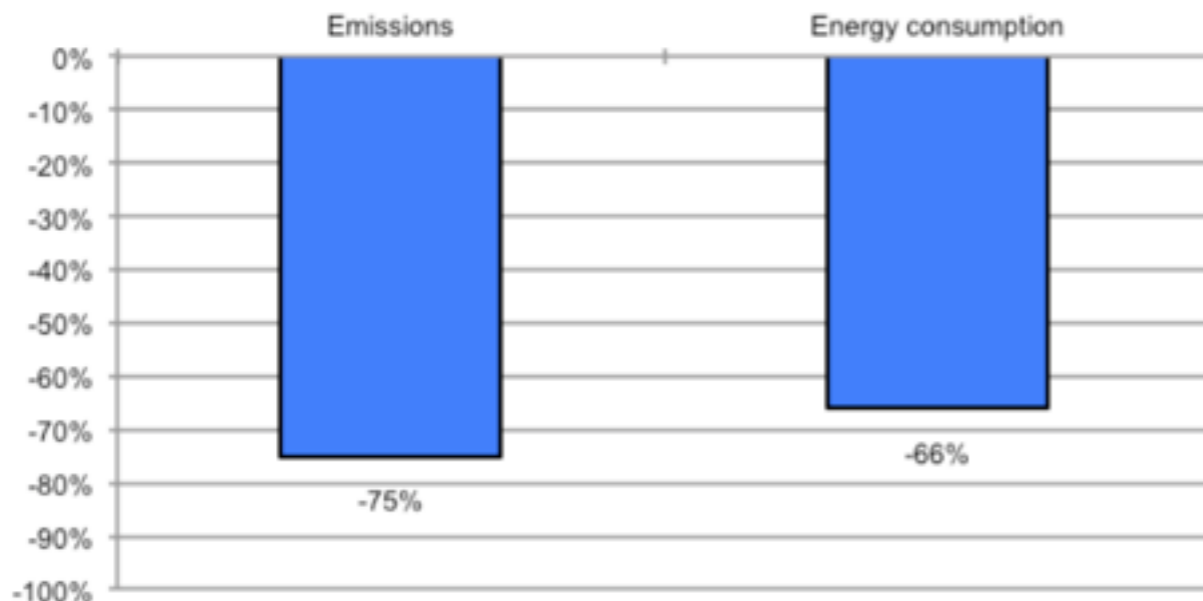
■ BF-BOF ■ Scrap-EAF



MAIN FLOWS OF EU-28 STEEL SCRAP EXPORTS 2014 (MILLION TONNES)



The Scrap-EAF route in comparison to the BF-BOF route

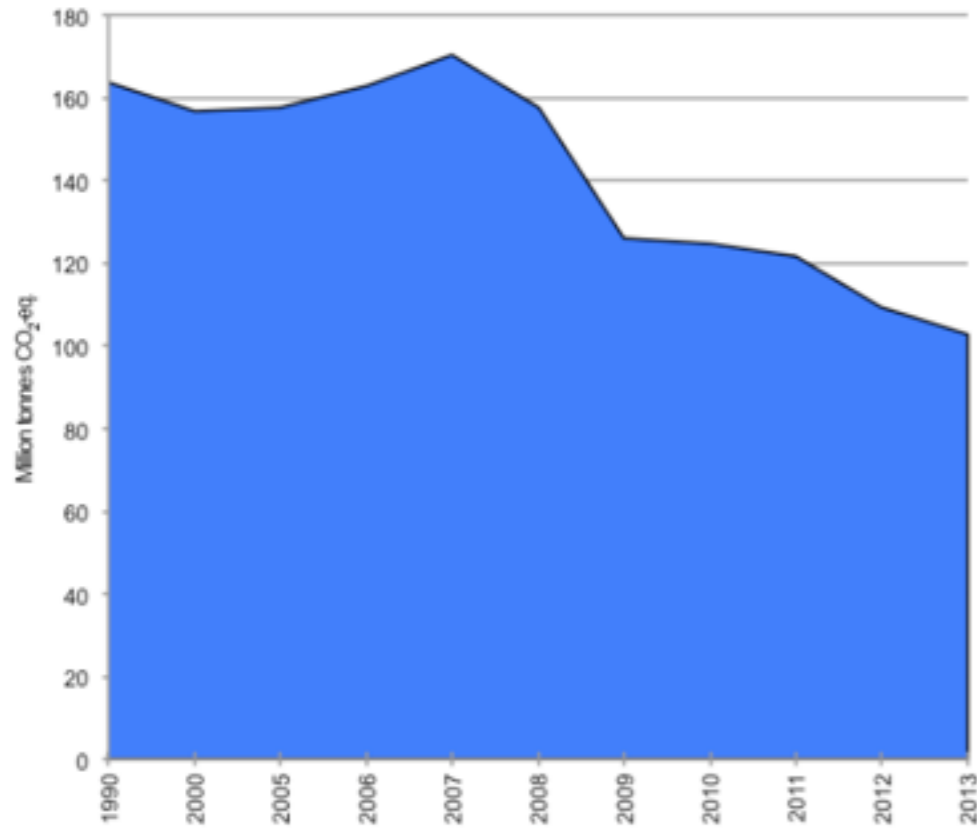


- **EU exports 16 million tonnes scrap-steel!**
- **Re-use/up-cycle scrap via Electric Arc Furnace (EAF) steel production**
- **less CO₂, less energy, less costs, ...**
- **Option to replace Blast Furnace surplus with (limited) EAF production**
- **Indirect EU ETS costs can be issue here...**

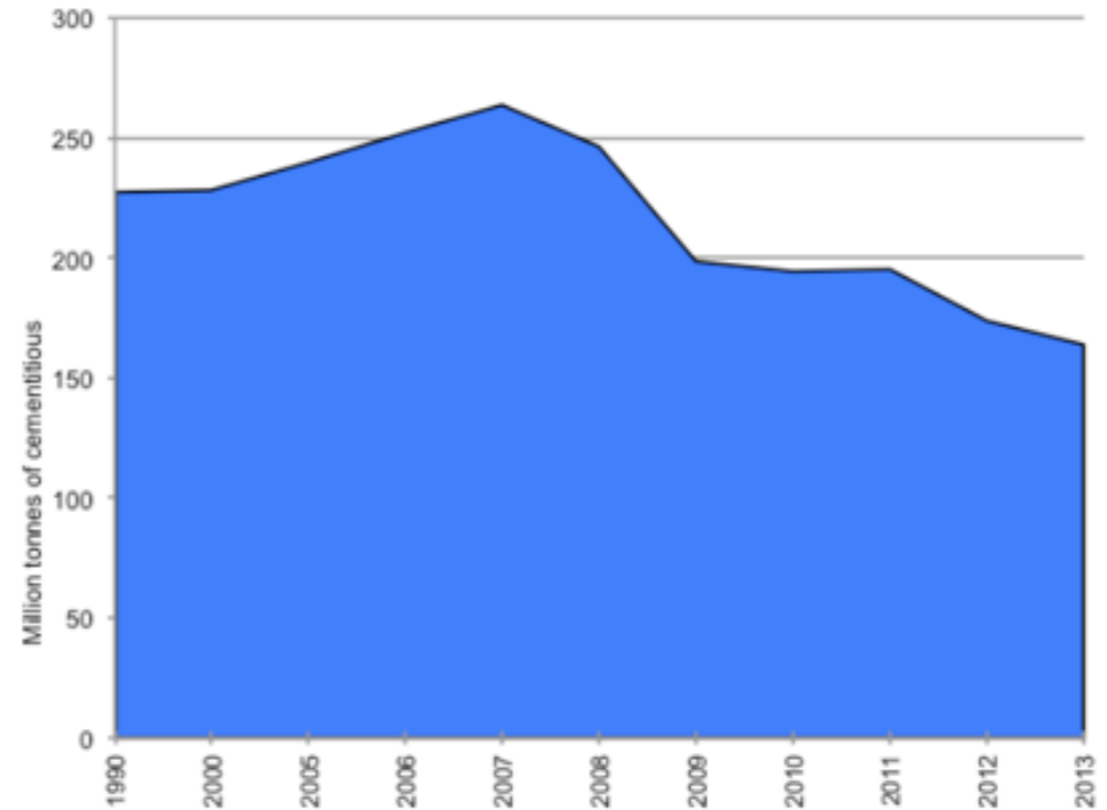
Cement Industry

Cement industry: Status

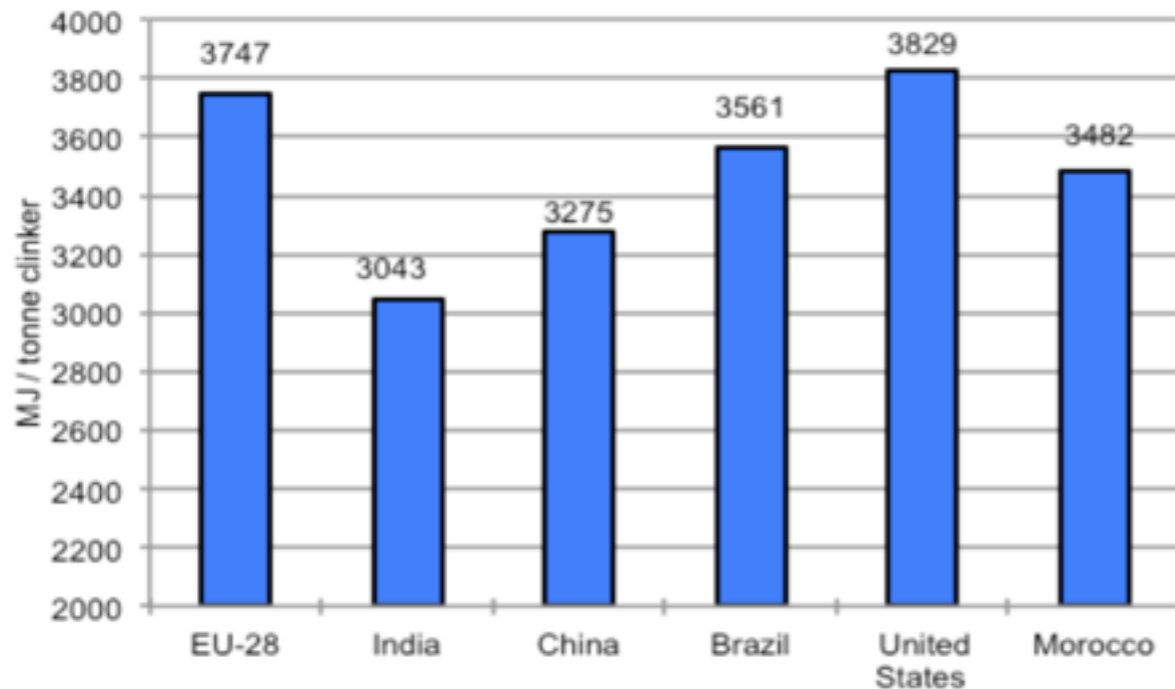
Emissions from EU Cement industry



EU production volume of cementitious



Thermal energy consumption per region

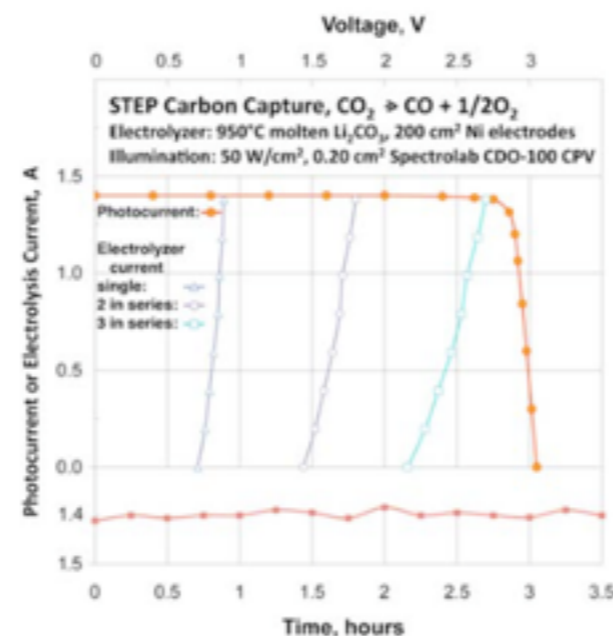
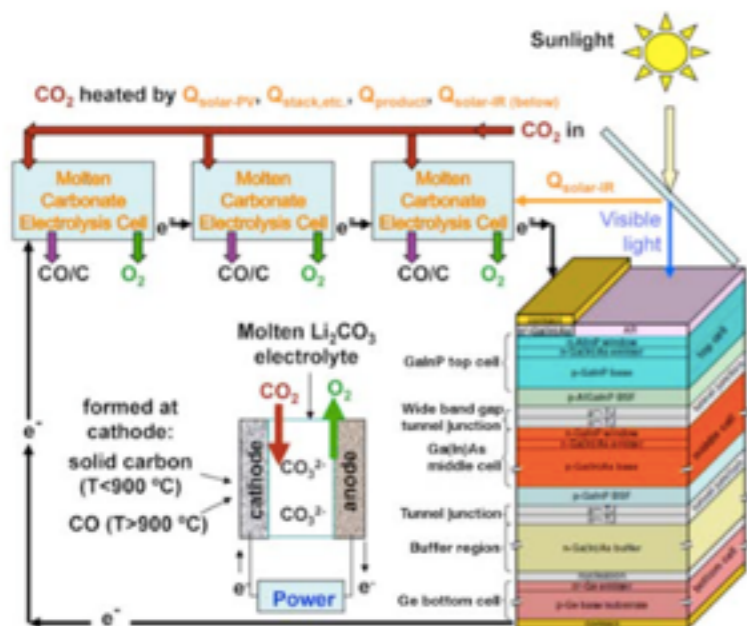


- Declining production & over-capacity
- Still (limited) inefficient production in EU
- Important to modernise and rationalise cement production → more resilience against e.g. carbon leakage

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)



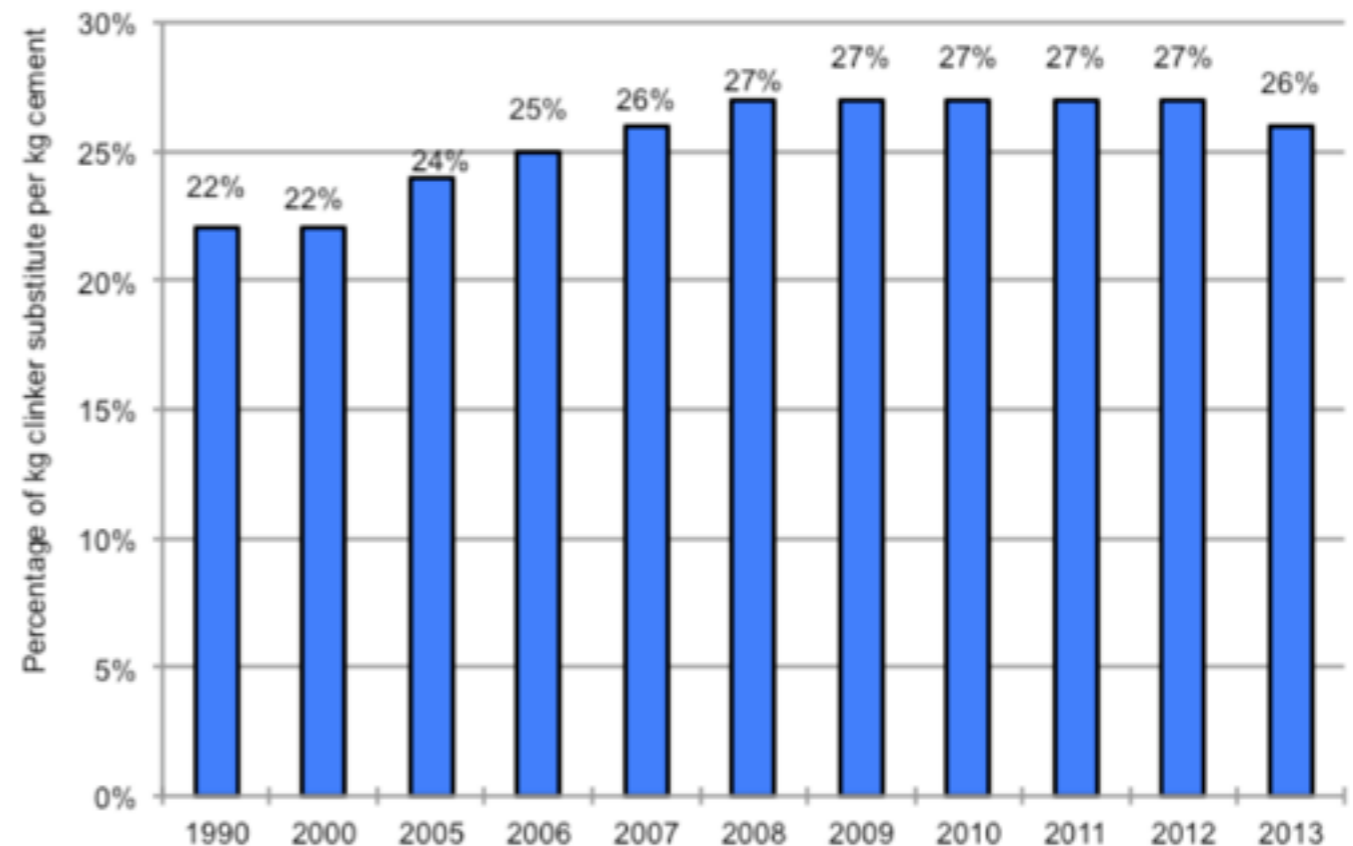
- Lime production via electrolysis
- Lab scale tested
- CO2 further reduced to CO or C

Cement industry: Clinker substitution

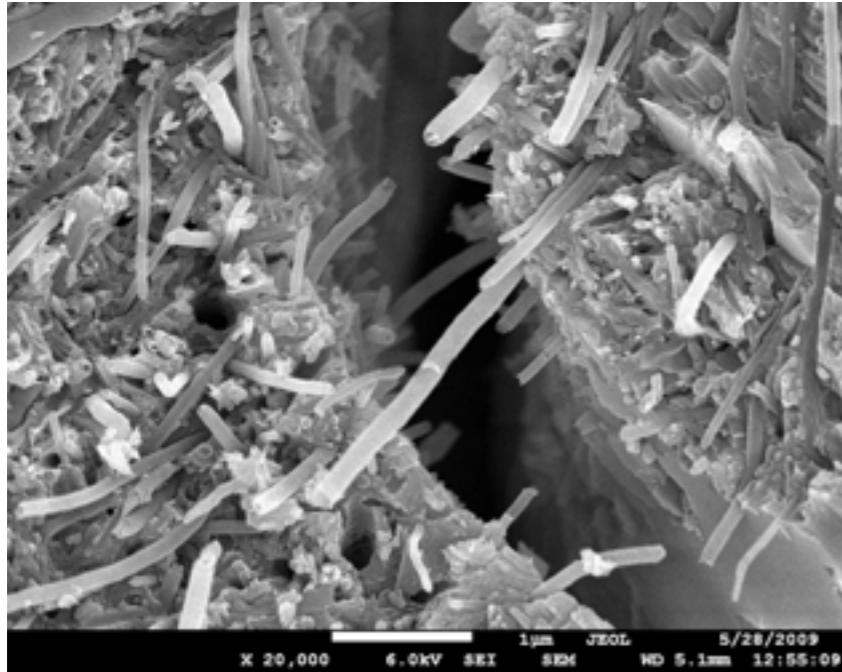


- **New clinker replacements needed**
- **Aether® cement: 30% less CO₂ per tonne clinker**
- **Plasmarok® from enhanced landfill mining. Can reduce EU cement emissions up to 11%**

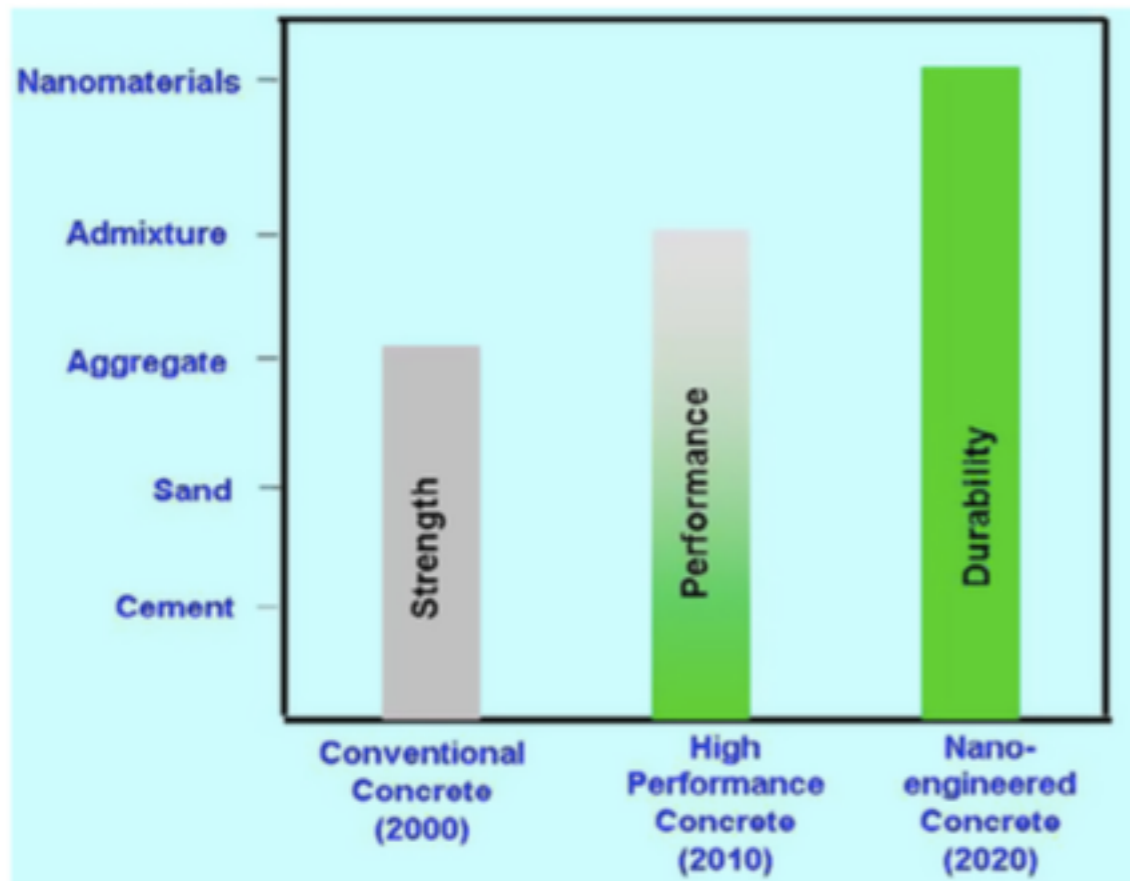
Use of clinker substitute as percentage of cement produced



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)**



Decarbonising Europe's energy intensive industries

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Tomas Wyns & Matilda Axelson

**Institute for European Studies
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“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.”



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