

The impact of the ETS exemptions for sectors at risk of carbon leakage on EU competitiveness

Final Report

February, 2014

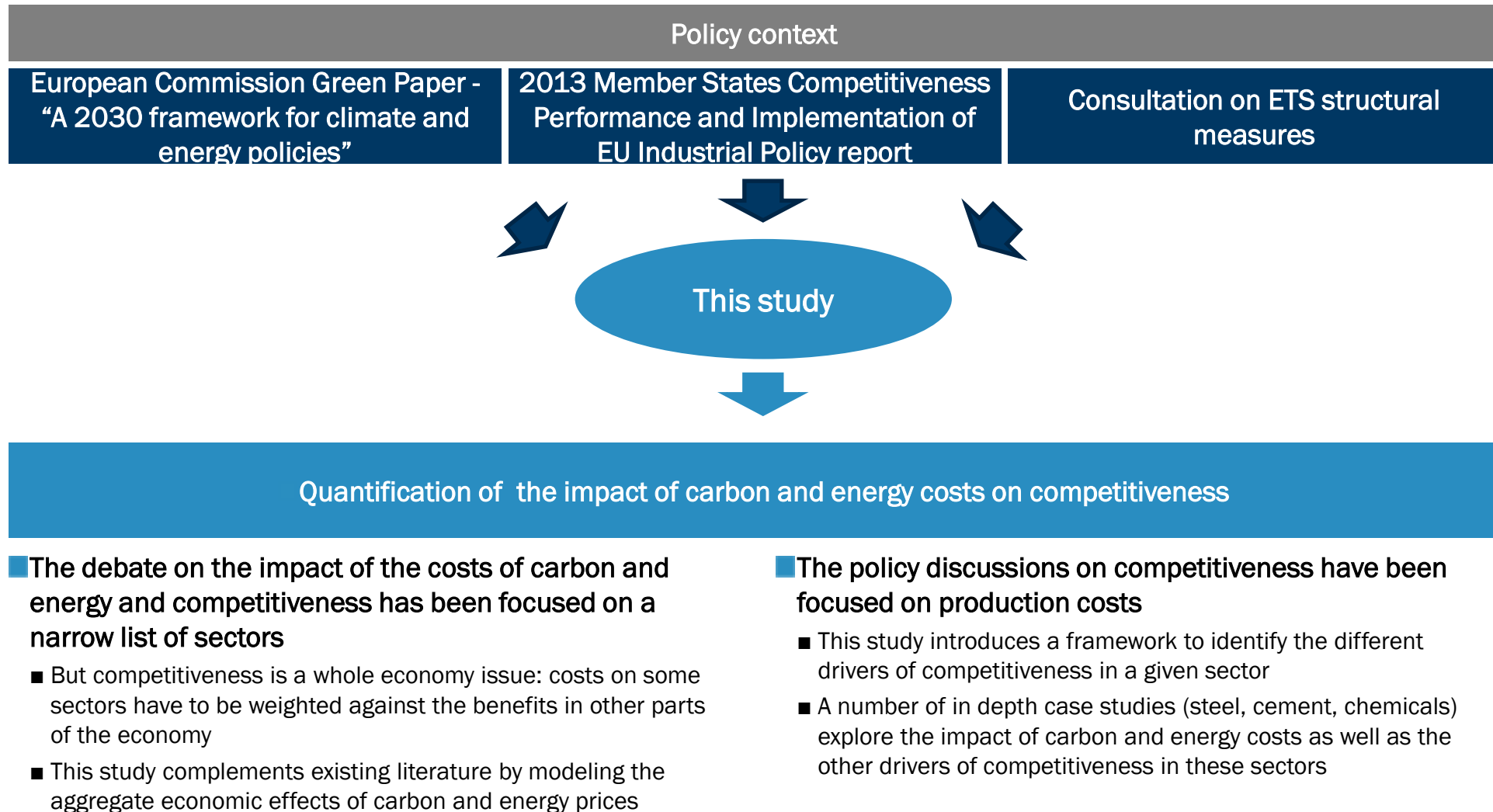
Presented To:  **Friends of ETS**

Table of content

■ Executive summary	3	■ Appendices	
■ Context and motivation for the project	31	■ Steel industry questionnaire and interviews	95
■ The ETS and Carbon Leakage		■ Steel sector competitiveness	103
■ Research questions		■ Detailed modelling of the steel sector	132
■ Proposed modelling approach: a cost-benefit analysis		■ Cement sector competitiveness	148
■ The costs of removing exemptions for carbon leakage sectors	46	■ Detailed modelling of the cement sector	162
■ Impact on representative sectors (steel, cement, chemicals)		■ Chemicals sector analysis	174
■ Scaling up the impact to the whole economy		■ Detailed results of scaling up of costs	187
■ The benefits of removing exemptions for carbon leakage sectors	76	■ Detailed results of benefits of removing exemptions for carbon leakage sectors	208
■ Recycling effects of government revenue (auctions and state aid savings)			
■ Conclusions: Net effects of removing exemptions for carbon leakage sectors on GDP and employment	88		

Executive summary

This study focuses on the interplay of carbon prices and economic competitiveness



As the ETS moves toward increasing auctioning of allowances in Phase 3 the EU addresses the issue of carbon leakage

CARBON LEAKAGE ISSUE

What is carbon leakage?

Carbon leakage is the situation when for reasons of costs related to climate policies production is transferred to countries which have laxer constraints on greenhouse gas emissions.

How does the ETS impact firm competitiveness?

The ETS impacts firms' competitiveness vis-à-vis firms operating in countries without climate policies through two channels:

- Direct carbon costs – firms need to purchase and surrender allowances to cover their carbon emissions
- Indirect carbon costs – firms pay higher electricity prices as power generators pass on the carbon costs to downstream consumers

How does the EU assess carbon leakage?

The EU has developed a framework of quantitative and qualitative criteria to assess the increased costs and the trade intensity of sectors.

Carbon leakage lists – 2013-2014 and 2015-2019

Based on the carbon leakage assessment framework the EC developed a list of carbon leakage sectors in 2009 that is valid for the 2013-2014 period. A revised list for the 2015-2019 period is to be finalized in 2014.

EU MEASURES TO ADDRESS CARBON LEAKAGE

Exemptions of carbon leakage sectors

The sectors deemed exposed to a significant risk of carbon leakage receive the following exemptions:

- Carbon leakage sectors continue to receive **free allowances** in Phase 3 (up to a benchmark and considering the sectoral constraints)
- Additionally, they may obtain **financial compensation** through national state aid schemes for increases in electricity costs resulting from the ETS

The EU assesses exposure to carbon leakage through quantitative and qualitative criteria

Quantitative Criteria

A sector is deemed to have a sufficient exposure to carbon leakage if it passes at least one of three quantitative criteria:

1. Joint Carbon Cost – Trade Intensity

Production costs would increase by at least 5% of GVA (Gross Value Added), AND

The sector's trade intensity is greater than 10%

2. Carbon Cost only

The increase in production costs is greater than 30%, as a proportion of Gross Value Added

3. Trade Intensity only

The intensity of trade is greater than 30%.

Qualitative Criteria

A more detailed analysis based on the following criteria:

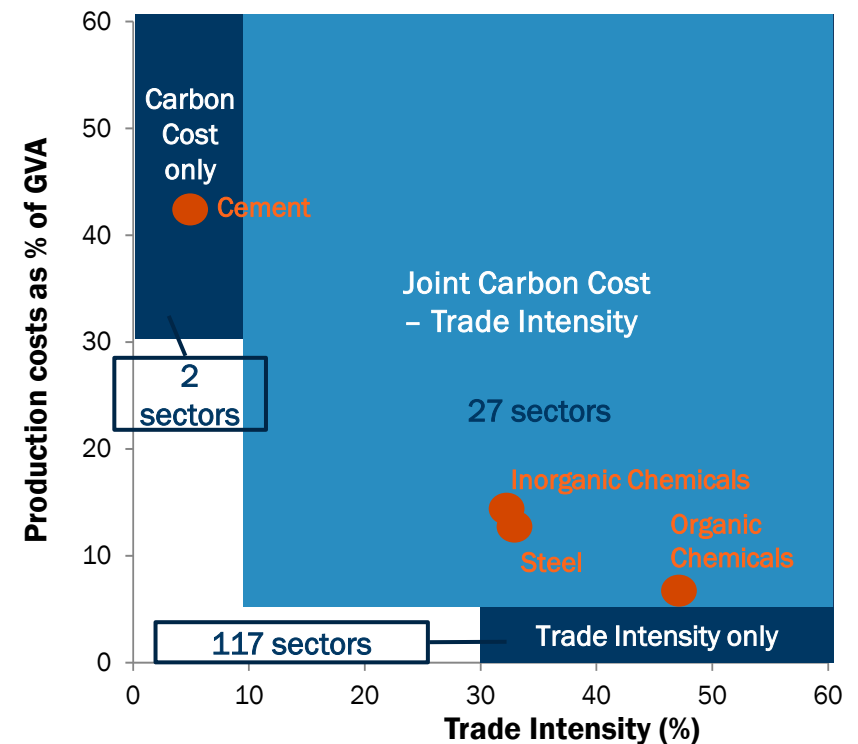
- The extent to which it is possible to reduce emission levels or consumption of electricity;
- Current and projected market characteristics; and
- Profit margins as an indicator of long-run investment or relocation decisions

Carbon Leakage List

164 sectors are on the Carbon Leakage list:

- 2 sectors are in the carbon cost only group;
- 27 sectors are in the joint group
- 117 sectors are in the trade intensity group
- 13 sectors qualify at sub-NACE 4 level
- 5 sectors qualify on qualitative criterion

Carbon leakage sector groups by assessment criteria



Steel sector: Removal of exemptions would impact BOF and EAF plants differently

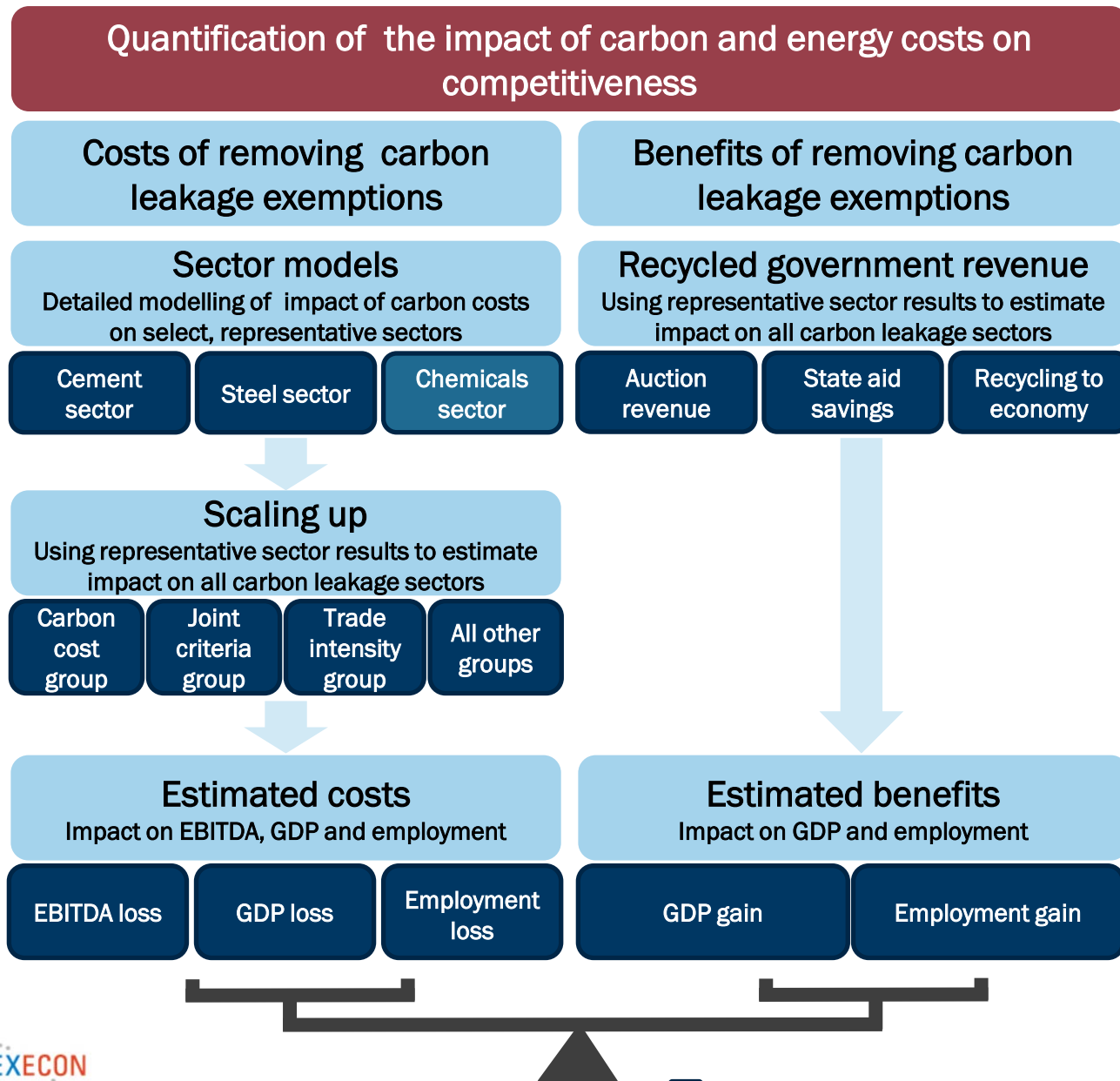
Carbon costs and competitiveness

- The steel industry is suffering from overcapacity and as a result from very strong intra-European competition. Import substitution is a secondary issue
- Part of steel production is carbon intensive but not energy intensive and the other part is energy intensive but not carbon intensive
 - 43% of production is with EAF technology that hardly emits carbon but is energy intensive
 - 57% of production is with BOF technology which is carbon intensive but significantly less energy intensive
- EU producers are the highest cost producers. Carbon costs would increase production costs significantly for BOF producers but not for EAF producers
- There are important barriers to import substitution and relocation
 - Barriers to import substitution include switching costs, qualification process, standards, transport costs, etc.
 - There are very few examples of successful relocation and few regions where relocation could be economical

Impact of removing Carbon Leakage exemptions

- Steel plants have been operating at low long term EBITDA margin levels due to overcapacity and strong intra-EU competition. Attempts to take out capacity have been met with political resistance
- EAF and BOF plants are facing very different risk of carbon leakage
- The impact of auctioning and indirect costs:
 - The impact on EAF plants is less than 2% point of EBITDA even at full auctioning and high carbon prices (€40)
 - The impact on BOF plants is significantly larger driven by their high emission intensity and not by their energy intensity. The fall in EBITDA margin remains under 2% point if
 - carbon prices remain low (€5/tonne of CO₂). In this case even full auctioning would not lead to higher than 2% point loss in EBITDA margin
 - carbon prices are at medium level (€20/tonne of CO₂) but auctioning percentage remains low (at 34% level)

The study quantifies the costs and benefits of removing carbon leakage exemptions of manufacturing sectors



Steel sector: Removal of exemptions would impact BOF and EAF plants differently

Carbon costs and competitiveness

- The steel industry is suffering from overcapacity and as a result from very strong intra-European competition. Import substitution is a secondary issue
- Part of steel production is carbon intensive but not energy intensive and the other part is energy intensive but not carbon intensive
 - 43% of production is with EAF technology that hardly emits carbon but is energy intensive
 - 57% of production is with BOF technology which is carbon intensive but significantly less energy intensive
- EU producers are the highest cost producers. Carbon costs would increase production costs significantly for BOF producers but not for EAF producers
- The steel industry has been over-allocated by free permits and indirect costs have not been substantial during the first two phases of the ETS
 - The industry appears to have banked enough allowances to carry it through to 2020
- There are important barriers to import substitution and relocation
 - Barriers to import substitution include switching costs, qualification process, standards, transport costs, etc.
 - There are very few examples of successful relocation and few regions where relocation could be economical

Impact of removing Carbon Leakage exemptions

- Steel plants have been operating at low long term EBITDA margin levels due to overcapacity and strong intra-EU competition. Attempts to take out capacity have been met with political resistance
- EAF and BOF plants are facing very different risk of carbon leakage
- The impact of auctioning and indirect costs:
 - The impact on EAF plants is less than 2% point of EBITDA even at full auctioning and high carbon prices (€40)
 - The impact on BOF plants is significantly larger driven by their high emission intensity and not by their energy intensity. The fall in EBITDA margin remains under 2% point if
 - carbon prices remain low (€5/tonne of CO₂). In this case even full auctioning would not lead to higher than 2% point loss in EBITDA margin
 - carbon prices are at medium level (€20/tonne of CO₂) but auctioning percentage remains low (at 34% level)

While the steel sector is facing strong intra-EU competitive pressures there are important barriers to import substitution

- Factors strengthening EU plants' competitiveness
- Factors neutral to EU plants' competitiveness
- Factors weakening EU plants' competitiveness

Strong supplier power

- High volatility of raw material prices demonstrates supplier power:

"Iron ore moved from \$35/ton 2004, to \$200/ton in 2008, then went back in 2009 to \$85 and bounced back in 2011 to \$200"
Steel industry expert

Important barriers to entry

- Economies of scale are extremely important for long term viability
- There are very high capital requirements
- Incumbents are ruthless in defending their market share
- There is significant overcapacity in the steel industry already

Strong rivalry within the EU

- High overcapacity: mills are trying to place some volume at all costs
- Relatively large number of competitors
- Part of production is differentiated but the other part is commodity
- Buyers' switching costs are lower for the commodity segment and higher for the specialty segment
- High capex is an important exit barrier

Buyer power is strong in the commodity but less so in the specialty segment

Specialty segment:

- Large buyers buy large volumes
- But qualification process and long term co-design relationship makes switching costly

Commodity segment:

- No product differentiation
- Price is key purchase criterion
- Switching costs are lower

Important barriers to import substitution

Although EU producers are the highest cost producers there are several barriers to import substitution:

- Imports are constrained by issues such as exchange rate volatility, lead time, working capital restrictions, lot sizes, serviceability, etc.

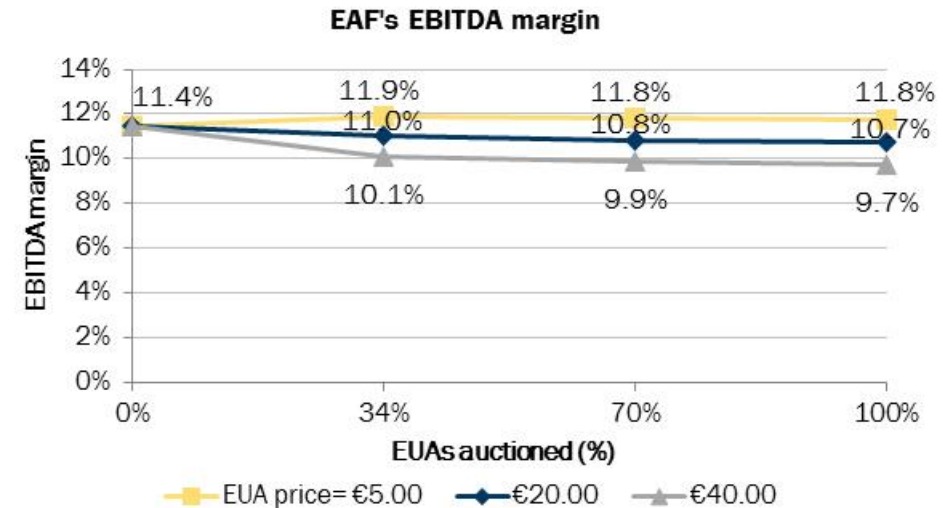
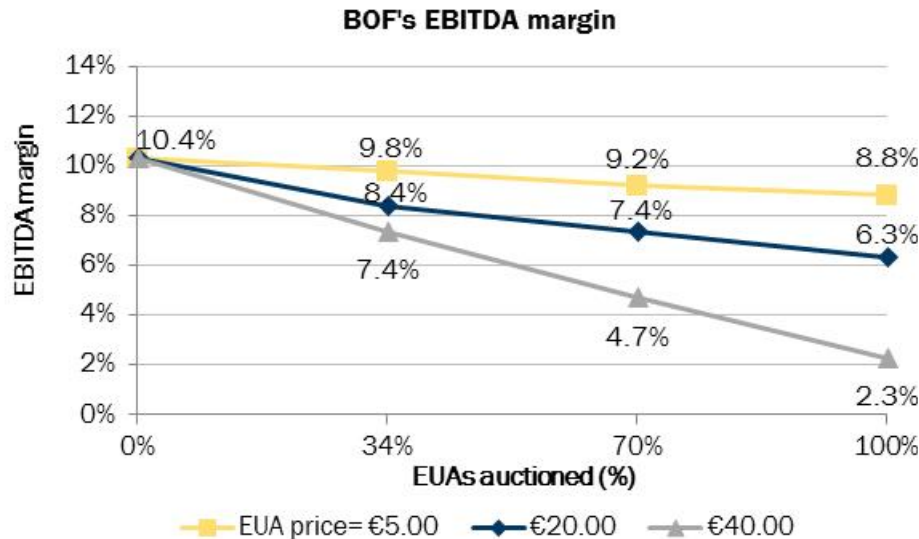
Specialty segment:

- OEMs have long term relationships with suppliers, switching costs are high
- EU has quality standards that few importers can meet

Commodity segment:

- Both volume and price of commodity orders are lower making transport costs significant

BOF plants are significantly impacted at higher carbon prices and auctioning, EAF plants are only marginally impacted



Source: FTI Consulting analysis

Impact of removing Carbon Leakage exemptions on BOF plants:

- BOF plants' EBITDA margin declines less than 2% point even at full auctioning if carbon prices remain at the €5 level
- In the effective ETS scenario with no compensation, BOF plants' EBITDA margin declines dramatically from 10% to 2%

Scenarios:

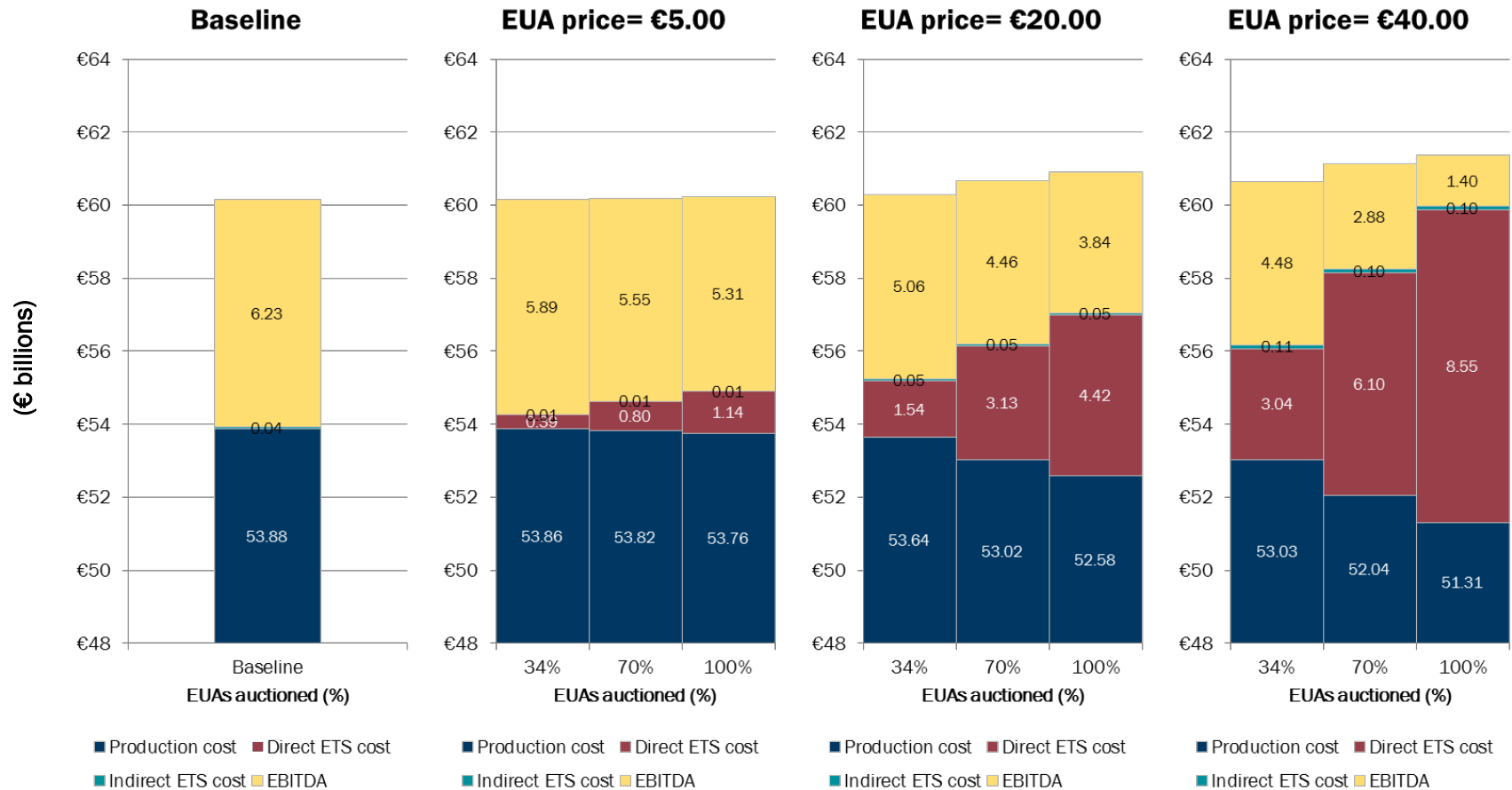
Carbon Price	Auctioning percentage		
	34%	70%	100%
€5/t	Ineffective ETS with high compensation	Ineffective ETS with medium compensation	Ineffective ETS with no compensation
€20/t	Moderately effective ETS with high comp.	Moderately effective ETS with med. comp.	Moderately effective ETS with no comp.
€40/t	Effective ETS with high comp.	Effective ETS with medium comp.	Effective ETS with no comp.

Impact of removing Carbon Leakage exemptions on EAF plants:

- EAF plants' EBITDA margin improves at the €5 carbon price level. This improvement is driven by the lower carbon prices compared to the baseline (€14 EUA)
- In the effective ETS scenario with no compensation, EAF plants' EBITDA margin declines by less than 2% points

The impact on BOF plants is driven by *direct* carbon costs

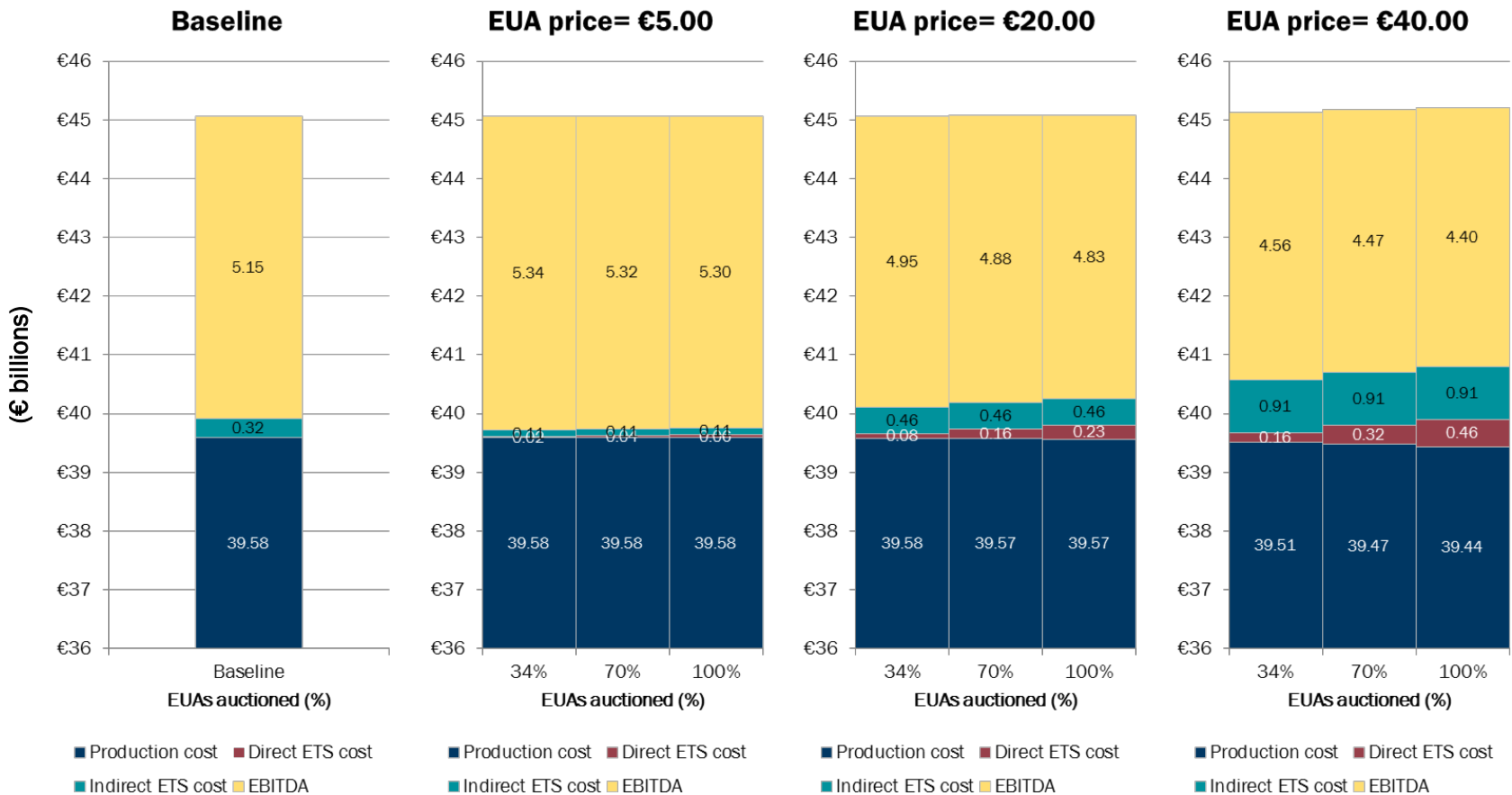
Composition of BOF revenue at different carbon prices and auctioning percentages



Source: FTI Consulting analysis

The impact on EAF plants is driven by *indirect* carbon costs

Composition of EAF revenue at different carbon prices and auctioning percentages



Source: FTI Consulting analysis

Cement sector: Removal of exemptions would impact inland and coastal plants differently

Carbon costs and competitiveness

- The cement sector's production volume fell by 70% since 2007. However the industry managed to keep EBITDA margins at over 20% and European operators have among the highest margins globally
- The cement industry does not qualify for indirect cost compensation. Indirect costs in the cement sector are about 3% of production costs even at high carbon prices (€40)
- The industry will be significantly impacted if it did not get free permits but there are strong barriers to import substitution and relocation
 - EBITDA margins could decline by 0.5% point to 19% point depending on carbon prices and auctioning percentages
 - Inland operators would be significantly less impacted than coastal operators:
 - At high carbon prices and full auctioning the EBITDA margin of inland operators would stay close to 20%, that of coastal operators would fall to 2%
 - High transport costs, concentrated market structure and quality restrictions create barriers to import and relocation

Impact of removing Carbon Leakage exemptions

- The impact of auctioning varies significantly between coastal and inland operators:

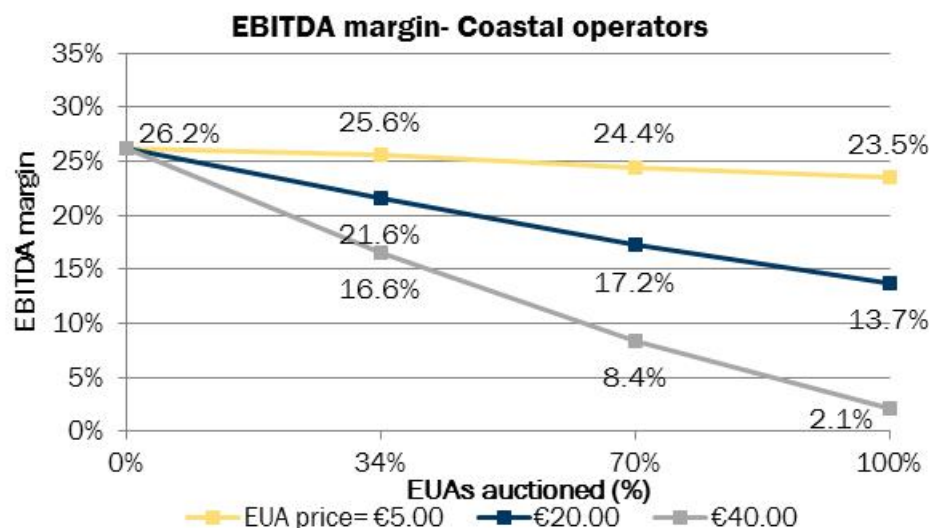
Inland operators

- Inland operators appear to have significantly higher margins than coastal operators
- The impact of auctioning on inland operators is negligible at low carbon price level (€5) even with full auctioning – less than 2% point of EBITDA
- The impact is significant at high carbon price levels (€40) and full auctioning – a fall of 13% point in EBITDA, however operators would retain close to 20% EBITDA margin even in this scenario

Coastal operators

- Coastal operators face larger threat of import substitution than inland operators
- The impact of removing exemptions on these operators would be marginal at low carbon prices (€5)
- At higher prices and auctioning levels the impact on margins becomes significant and EBITDA margins drop to 2% at €40 carbon prices and full auctioning

Coastal plants are significantly impacted at higher carbon prices, inland plants retain close to 20% EBITDA margins even in the strictest scenario



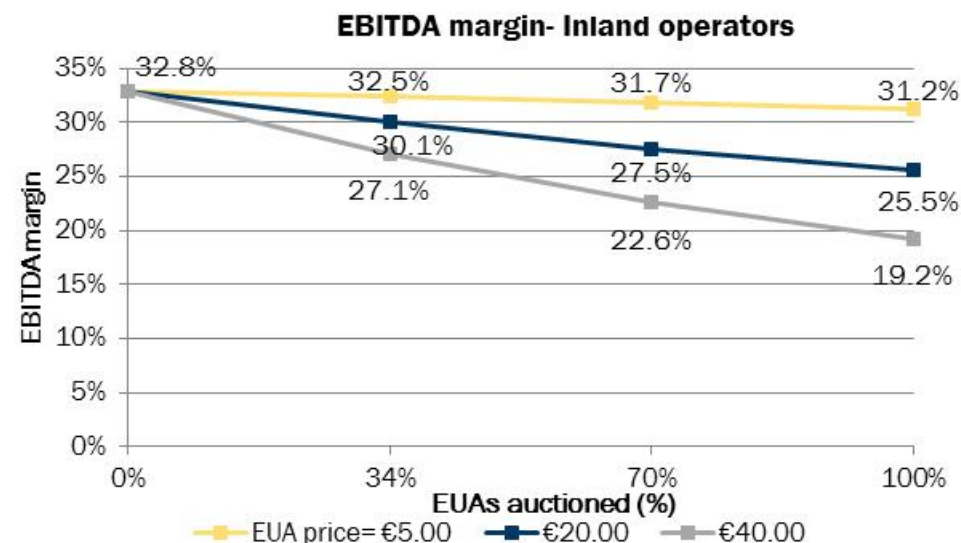
Source: FTI Consulting analysis

Impact of removing Carbon Leakage exemptions on coastal operators:

- Coastal operators' EBITDA margin declines less than 3% point even at full auctioning if carbon prices remain at the €5 level
- In the effective ETS scenario with no compensation, coastal operators' EBITDA margin declines dramatically from 26% to 2%

Scenarios:

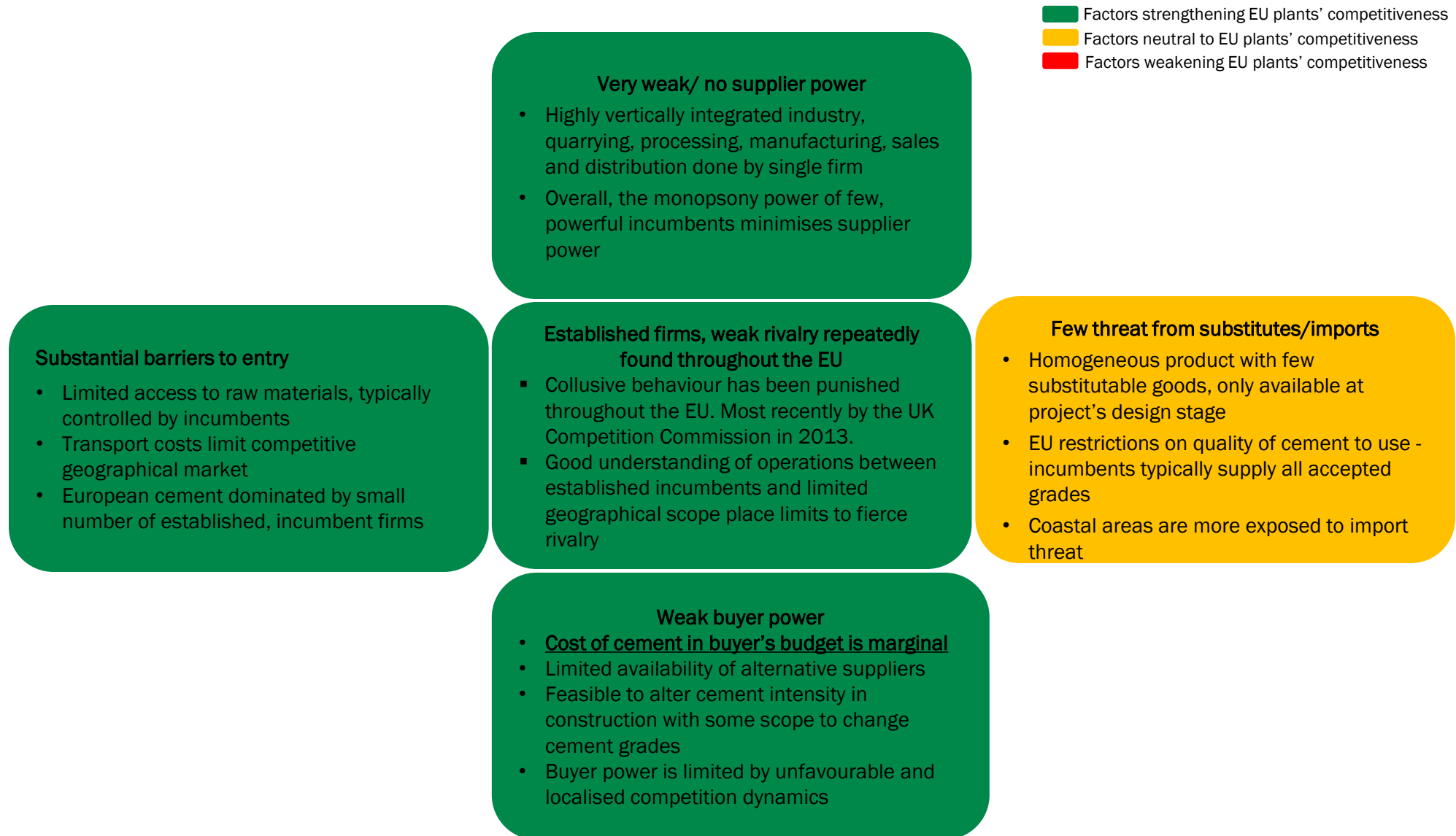
Carbon Price	Auctioning percentage		
	34%	70%	100%
€5/t	Ineffective ETS with high compensation	Ineffective ETS with medium compensation	Ineffective ETS with no compensation
€20/t	Moderately effective ETS with high comp.	Moderately effective ETS with med. comp.	Moderately effective ETS with no comp.
€40/t	Effective ETS with high comp.	Effective ETS with medium comp.	Effective ETS with no comp.



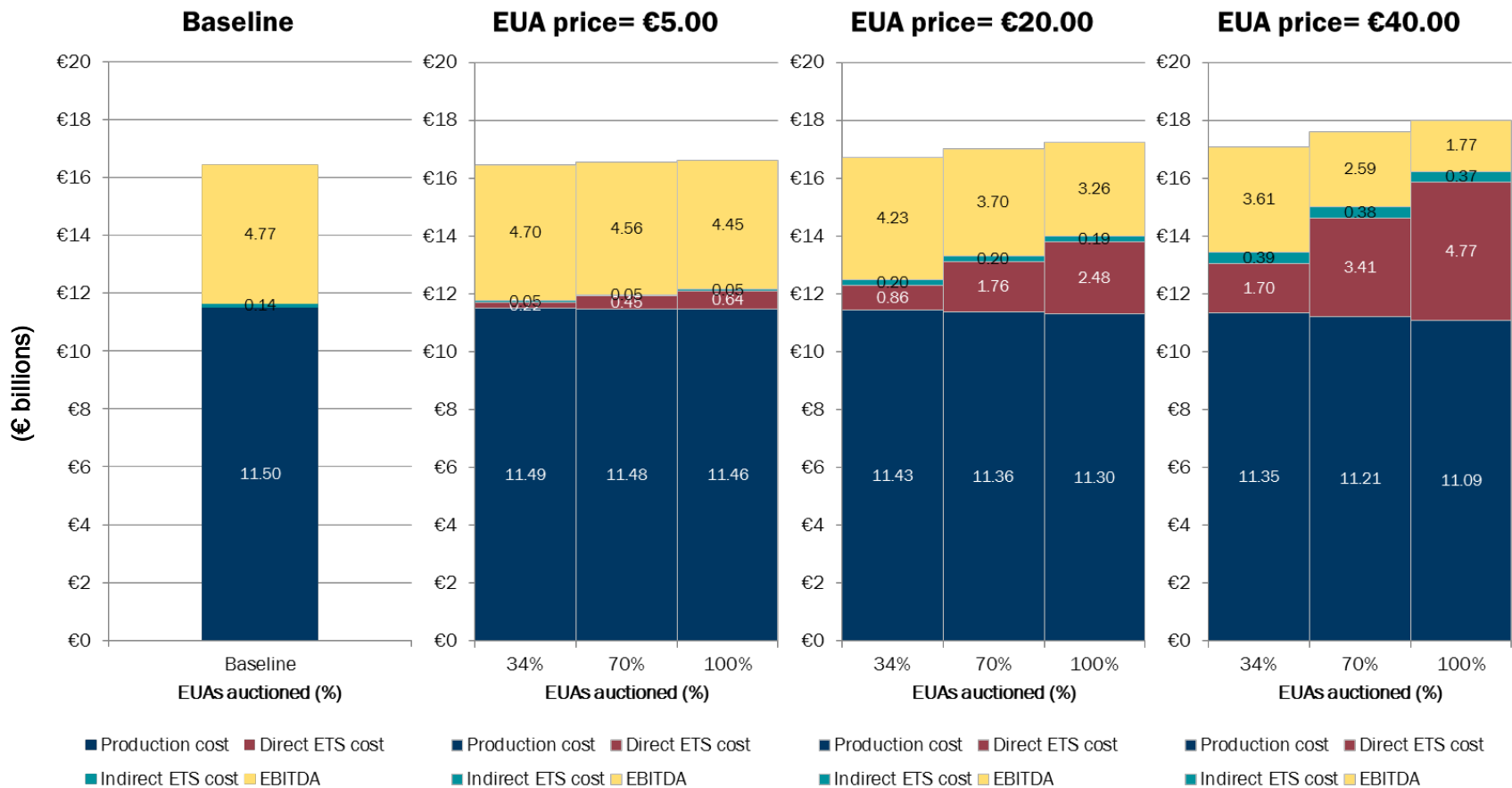
Impact of removing Carbon Leakage exemptions on inland operators:

- Impact on inland operators' EBITDA margin is negligible at €5 carbon price level
- In the effective ETS scenario with no compensation, inland operators are significantly impacted (a fall of 13% point EBITDA) but are able to retain close to 20% margins

Cement sector competitiveness framework highlights significant market power of cement firms



The impact on cement plants is driven by *direct* carbon costs



Source: FTI Consulting analysis

All sectors: Removal of exemptions would impact the “carbon only” and the “joint criteria” groups but less so the “trade intensity” group

Carbon leakage sectors in policy discussions

- Policy discussions are dominated by a few sectors: steel, cement, chemicals, oil refining, aluminium and paper and pulp. These are not representative of the 164 sectors on the Carbon Leakage list
 - The sectors dominating the policy discussions belong to two groups on the carbon leakage list: carbon cost only and joint criteria. There are no sectors representing the 117 trade intensity sectors and the 18 ‘other’ sectors
- Albeit the second largest polluter, the cement sector is actually a very small sector in terms of turnover and employment
 - The cement sector employs around 60 thousand employees compared to the steel sector’s over 400 thousand. Turnover of the cement sector is €20 billion while that of the steel sector is €165 billion[†]
- Several recent studies have argued that the trade intensity criterion was set extremely conservatively and resulted in a highly inflated carbon leakage list
 - There is no detailed analysis of any of these sectors in the academic and consulting literature
 - Yet these sectors account for 64% of the turnover and 82% of the employment of the carbon leakage groups[†]

Impact of removing Carbon Leakage exemptions

- The impact of removing exemptions varies significantly across the 3 main carbon leakage groups:

Carbon only group

- The carbon only group’s EBITDA margin and employment is essentially unchanged at low carbon price levels (€5) but margins decline by 18% point and employment by 8% in the most severe scenario
- Total turnover and employment of this group is very small relative to the other groups’

Joint criteria group

- Despite the steel sector’s sensitivity to carbon costs, the group as a whole does not seem to be impacted by carbon costs
- This is driven by the fact that the steel sector alone emits as much carbon as the other 26 sectors in this group altogether

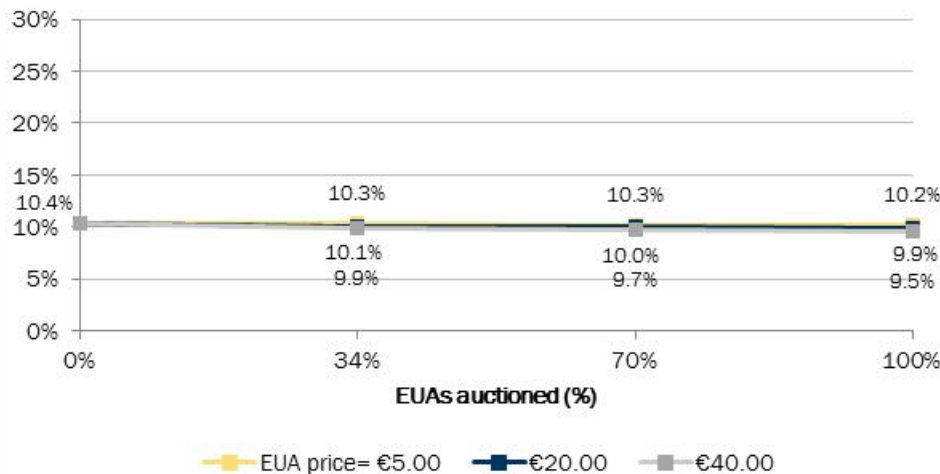
Trade intensity group

- Even at conservative estimates (i.e. the group is expected to not pass on any of the carbon costs to consumers), the impact on the trade intensity group’s margin is negligible. As costs are not expected to be passed through a significant volume or employment decline for these sectors is not expected

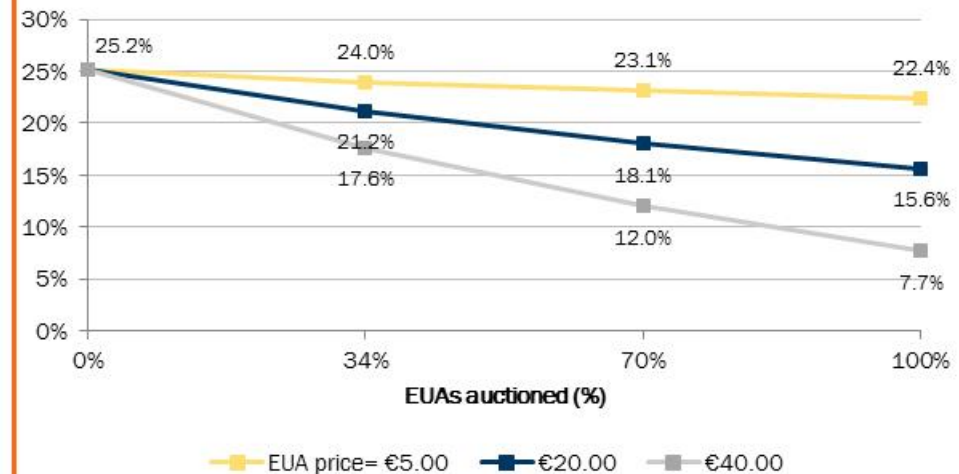
[†]Employee and turnover figures are averages for 2003-2010

Only the carbon cost group experiences significant declines in EBITDA margin- the impact on the carbon leakage groups' overall EBITDA margin is modest

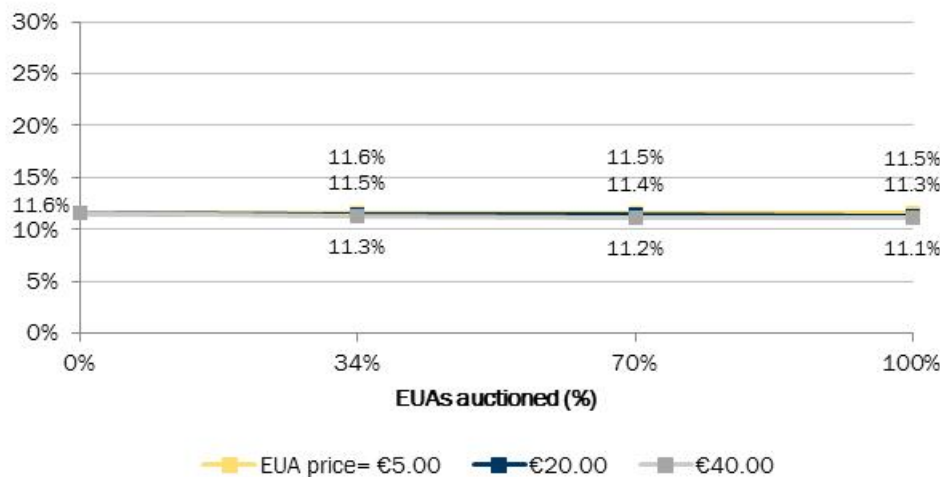
Major Carbon Leakage groups' EBITDA margins



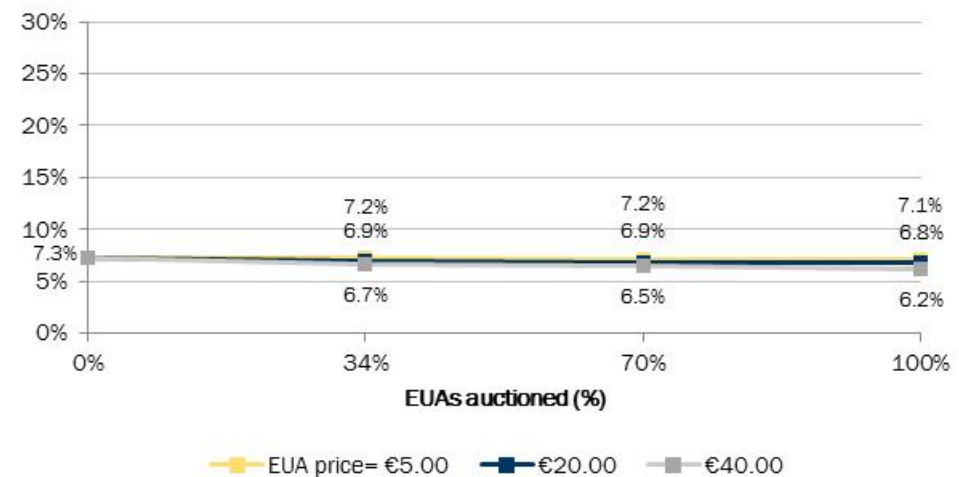
Carbon cost group's EBITDA margin



Trade intensity group's EBITDA margin



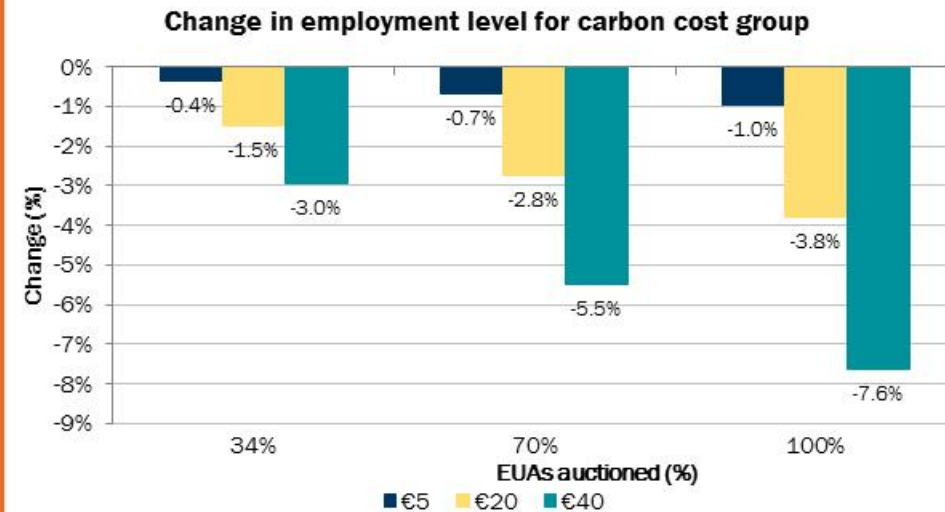
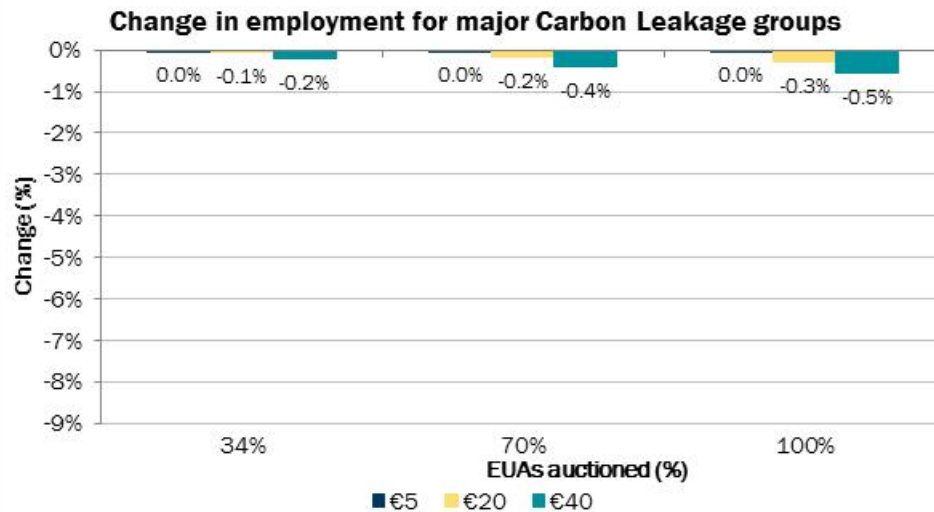
Joint group's EBITDA margin



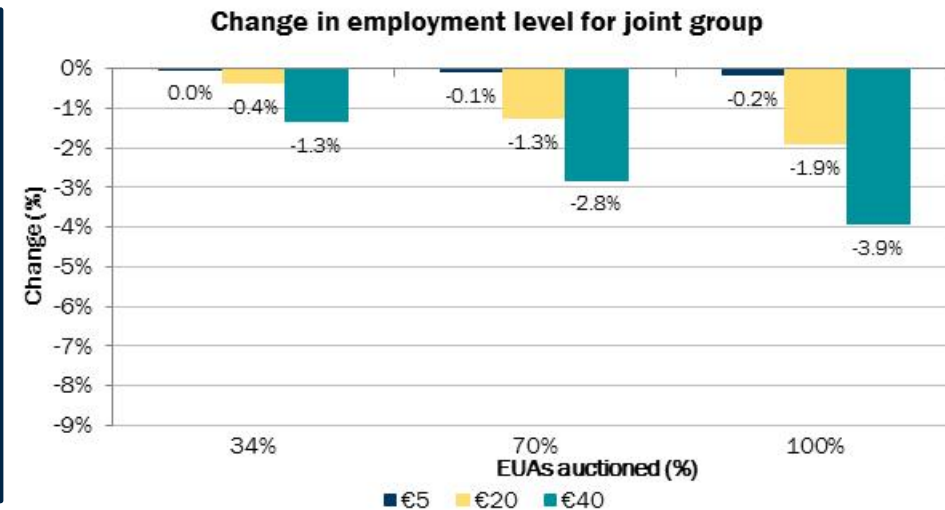
Source: FTI Consulting analysis

Note: Only the carbon cost, joint and trade intensity groups of the Carbon Leakage list are included in the analysis

Employment decline is negligible for the carbon leakage groups as a whole but it is up to 8% for the carbon cost group



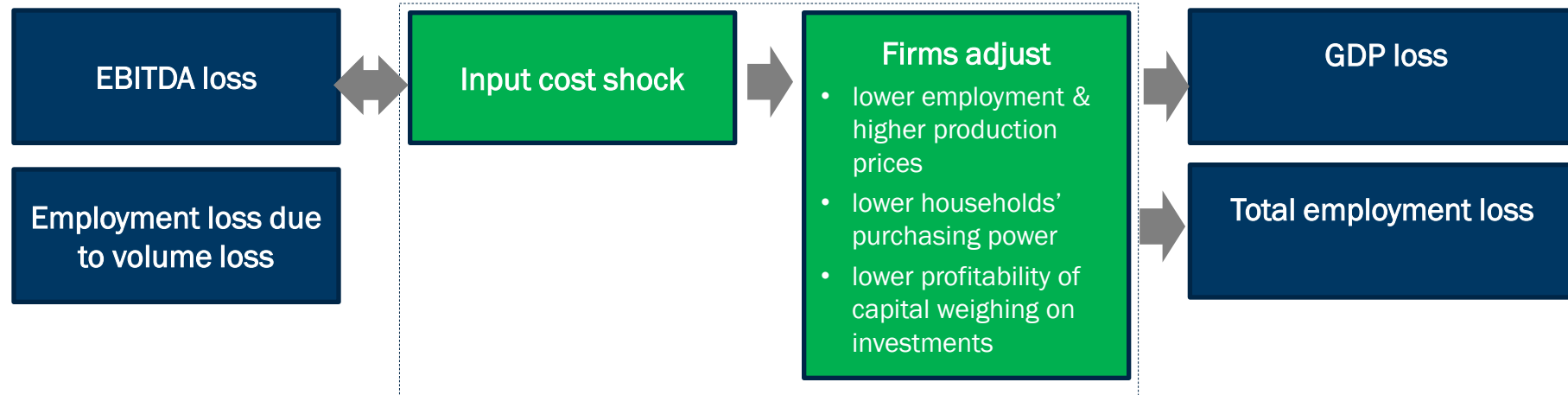
Trade intensity sectors are assumed to absorb the costs by in EBITDA. There is no estimated employment impact.



Source: FTI Consulting analysis

Note: Only the carbon cost, joint and trade intensity groups of the Carbon Leakage list are included in the analysis

Dynamic impact of direct EBITDA and employment loss



Methodology and calculations

GDP loss

- Typical impact of cost shock on GDP: 1ppt increase in labour social contributions decreases GDP by 0.3ppt
- This is a relatively optimistic order of magnitude since the profitability of capital is also lessened when the carbon price increases.
- We considered two scenarios: 1.) The lower case assumes that only the cost of labour is modified. 2.) The upper case assumes that both the labour cost and the remuneration of capital are modified.
- Then we calculated a 0.3-0.4% increase in costs and a corresponding upper case of -0,02% GDP loss and a lower case of -0,01% GDP loss
- We used EU GDP (of 12,899 billion) to calculate the total GDP loss.

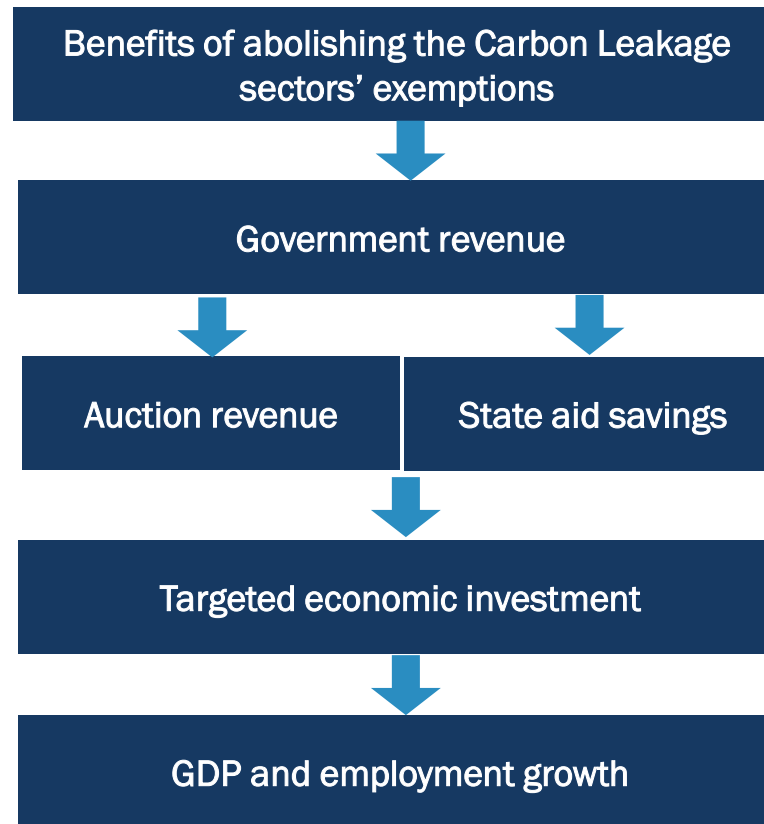
Employment loss

- An increase in labour costs impacts employment through the elasticity of labour supply to the cost of labour.
- We use standard macroeconomic simulations of a rise in the cost of labour and its impact on employment in France.
- We apply a limited correction to the result obtained so that the average wage of labour flowing from these estimates corresponds to the average EU remuneration of labour.

GDP loss ranges from €2bn to €24bn and employment from 16K to 255K in the different scenarios

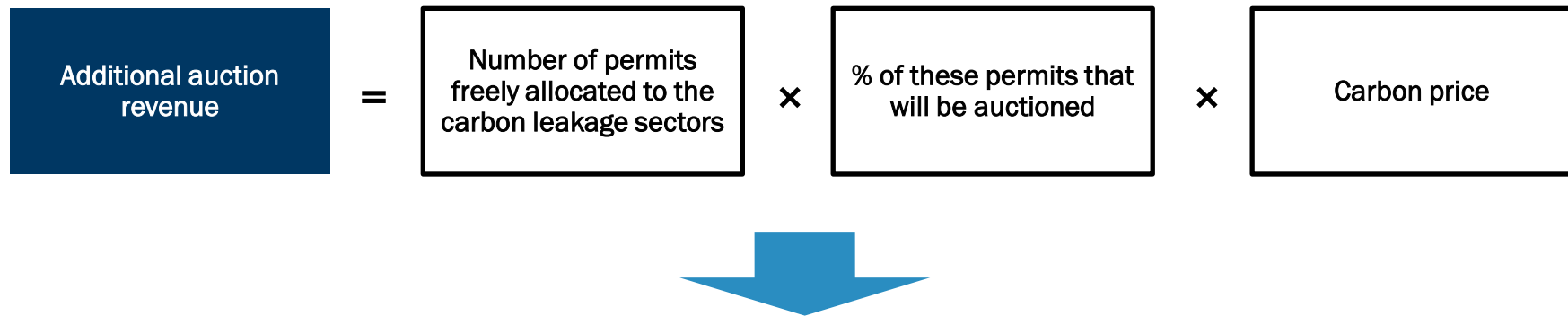
Scenario	EBITDA loss	GDP loss	Commentary
Carbon price: €5/t Auctioning: 34%	€ 2,2bn	€1,5bn - €2,0bn	<ul style="list-style-type: none"> If carbon leakage exemptions are removed the economy is expected to lose between €1,5bn - €23,6bn (0.01-0.2% of EU GDP) depending on the scenario.
Carbon price: €20/t Auctioning: 70%	€ 10,6bn	€7,0bn - €9,5bn	
Carbon price: €40/t Auctioning: 100%	€ 26,3bn	€17,5bn - €23,6bn	
Scenario	Direct employment loss	Total employment loss	Commentary
Carbon price: €5/t Auctioning: 34%	600	16,000 - 22,000	<ul style="list-style-type: none"> If carbon leakage exemptions are removed the economy is expected to lose between 16,000 - 255,000 employees (0.1-1.7% of Carbon Leakage sectors' employment and 0.01-0.1% of EU employment) depending on the scenario.
Carbon price: €20/t Auctioning: 70%	26,000	76,000 - 103,000	
Carbon price: €40/t Auctioning: 100%	80,000	189,000 - 255,000	

The main source of benefits from removing carbon leakage exemptions is government revenues that can be recycled into the economy



If carbon leakage exemptions are abolished governments will receive revenue from auctioning permits...

Calculation of additional auction revenue if carbon leakage exemptions are removed:



Estimates of additional auction revenue range from €1 billion - €30 billion:

Estimates of EUA auction revenue (€ billion)			
EUA price (€/tonne)	Auctioning percentage		
	34%	70%	100%
5	1.3	2.6	3.7
20	5.0	10.3	14.7
40	10.0	20.6	29.5

Source: FTI Consulting analysis

... and will save state aids offered as a compensation for indirect costs

Estimates of the magnitude of the state aid differ between Member States

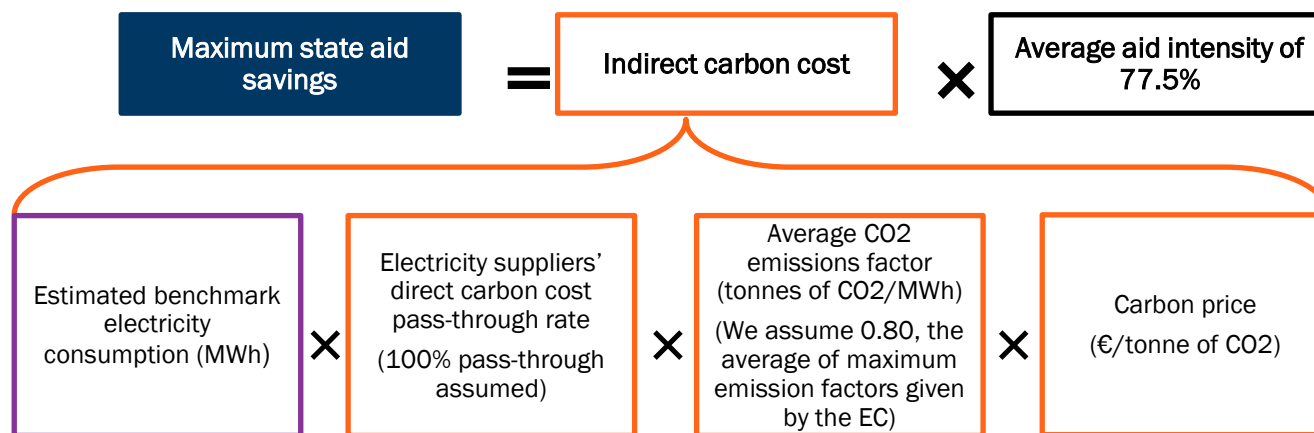
- The German government has set aside **€350 million** for 2013 (Source: BUND, 2013), and the aid intensity is expected to be approximately **70%** (Oeko Institute for Applied Ecology, 2013)
- The UK government has allocated up to £113 million over the Spending Review Period (approximately £50m or **€59m annually**), and the aid intensity is intended to be the maximum permissible **85%** (BIS, 2013)
- The Dutch government intends to provide €624m over eight years (approximately **€78m annually**)

Our modelling approach – 2 scenarios:

- Other Member States may also intend to provide such aid, but details have not been published
- We therefore estimate state aid savings in two scenarios:

State aid saving scenario	Description	Details
1	ONLY Germany, the UK and the Netherlands provide state aid	The total state aid is therefore €487m (sum of €350m for Germany, €59m for UK, and €78m for the Netherlands)
2	All Member States provide state aid	We assume the average EU wide aid intensity is 77.5% (i.e. the average of the UK and Germany)

Modelling method and assumptions:



We also estimate the fall in corporate tax revenue as a result of the carbon leakage sectors' loss of EBITDA

- We estimate the fall in corporate tax revenue as:

$$\text{Fall in corporate tax revenue} = \text{Fall in taxable income} \times \text{Corporate tax rate}$$

Fall in taxable income

- We estimate the fall in taxable income using the fall in EBITDA modelled for the carbon leakage sectors
- We recognise that EBITDA is not the same as taxable income – so this is a simplifying assumption
- For example, although tax rules differ between Member States, adjustments are made to EBITDA to calculate taxable income (for example, a depreciation expense may be deducted)
- The fall in EBITDA varies from €2.2bn (when the carbon price is €5 and 34% of permits are auctioned), to €42.4bn (when the carbon price is €40 and 100% of permits are auctioned)

Corporate tax rate

- We use a representative corporate tax rate of 27.8%
- Since our modelling is at the EU level (and not country by country), we use a single tax rate
- Corporate tax rates vary within the EU, from 10% (in Bulgaria and Cyprus) to 35% (in Malta)
- We calculate a weighted average corporate tax rate of 27.8%, using the Member States' GDP in 2012 (at market prices) as a weight

We model this as a reduction in government spending across the economy, in proportion to the government's existing pattern of spending

We model three scenarios for the recycling of government revenues into the economy

Scenarios:

1. The additional revenue is spent in line with the existing pattern of government spending

- Member States' governments spend the majority of their budgets on public administration, defence, education, health and social work
- In this scenario, we assume that the additional revenue is distributed similarly to other general tax revenues

2. The additional revenue is earmarked for research and development and clean technologies

- In this scenario, we assume that the funds are designated according to the EC's six "Priority Action Lines" for investment, based on an example of the sectors in which this investment could take place

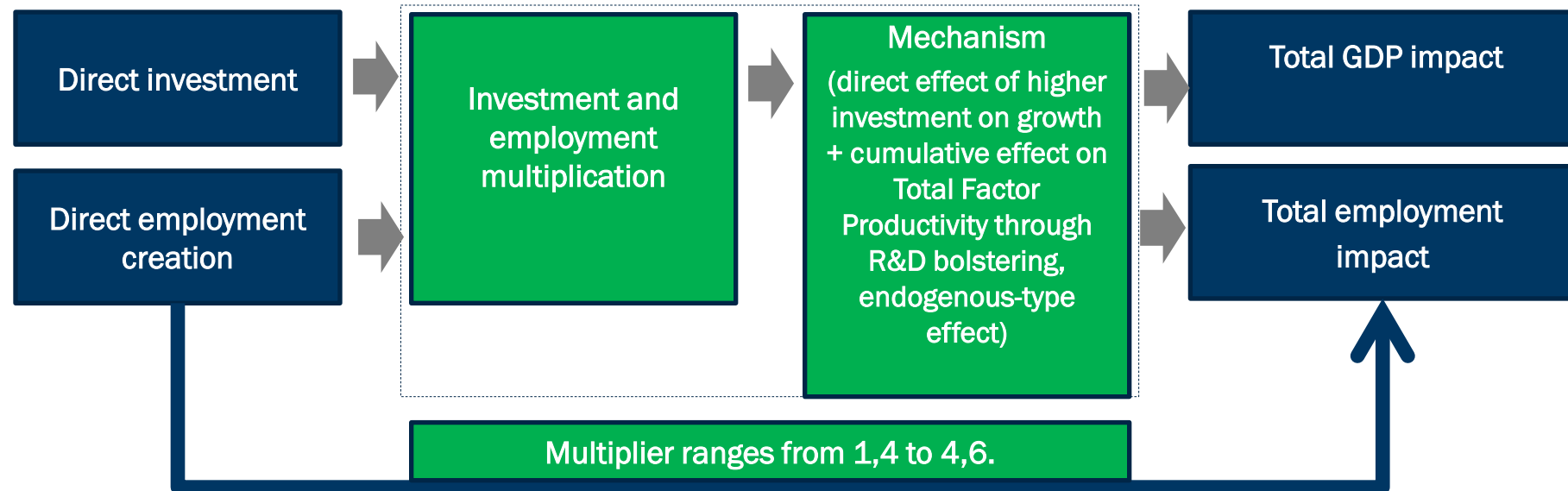
3. The additional revenue is earmarked for the manufacturing sector

- In this scenario, we assume that the funds are distributed back to the manufacturing industry

Product category	Allocation of additional government spending		
	Existing pattern of spending	R&D, clean technologies	Manufacturing
Products of agriculture, forestry and fishing	0%	0%	0%
Mining and quarrying	0%	0%	0%
Manufactured products	2%	40%	100%
Electricity, gas, steam and air conditioning	0%	0%	0%
Water supply; sewerage, waste management and remediation services	0%	0%	0%
Constructions and construction works	0%	20%	0%
Wholesale and retail trade services; repair services of motor vehicles and motorcycles	2%	0%	0%
Accommodation and food services	0%	0%	0%
Transportation and storage services	1%	0%	0%
Information and communication services	0%	0%	0%
Financial and insurance services	0%	0%	0%
Real estate services	1%	0%	0%
Professional, scientific and technical services	2%	40%	0%
Administrative and support services	0%	0%	0%
Public administration and defence services; compulsory social security services	38%	0%	0%
Education services	20%	0%	0%
Human health and social work services	31%	0%	0%
Arts, entertainment and recreation services	2%	0%	0%
Other services	0%	0%	0%
Services of households as employers; undifferentiated goods and services produced by households for own use	0%	0%	0%
Services provided by extraterritorial organisations and bodies	0%	0%	0%
Total	100%	100%	100%

Source: Eurostat Input-Output tables (2009), FTI Consulting analysis

Multiplicative effect of targeted investments



Methodology and calculations

Relevant multipliers in the literature

- Public investment for high technologies with dual impact (military and civilian). Ramey (2008) suggests here a multiplier of 1,5 (using a VAR model). A monography of Oxford Economics on BAE suggests a multiplier between 1,4 and 1,7.
- Tax expenditures in favour of R&D can also entail sizeable dynamic, leverage effects. Mulkay and Mairesse (2004) find that 1€ of tax expenditures fostering R&D increase total R&D by 3€ to 4,6€, including 2€ to 3,6€ from the private sector.
- The QUEST III model used by the European Commission (Arpaia, Roeger et al., 2007) suggests that a rise in R&D spending of 1,1% of GDP would trigger an upward effect on GDP of slightly less than 2,6%.

Total GDP and employment impact calculation

- Assuming that the elasticity of employment to GDP is 1 in the long-run – which has strong theoretical justifications, we directly derive the effect on employment using the average cost of labour in the EU27.

The impact of removing carbon leakage exemptions on economic output ranges from €3bn in an ineffective ETS scenario to €61bn in an effective ETS scenario

(€ billions)	Ineffective ETS with high compensation	Moderate ETS with medium compensation	Effective ETS with no compensation
Carbon price	€5	€20	€40
% auctioning	34%	70%	100%
Initial change in EU wide final demand			
(1) Additional EUA auction revenues†	€1.3bn	€10.3bn	€29.5
(2) State aid savings†	€0.8bn	€3.3bn	€6.6bn
(3) Reduction in corporation tax†	- €0.6bn	- €2.9bn	- €7.3bn
Total (1 + 2 + 3)	€1.5bn	€10.7bn	€28.8bn
Multiplicative change in economic output and employment			
Additional EU GDP	€3bn <i>(0.02% of EU GDP)</i>	€23bn <i>(0.2% of EU GDP)</i>	€61bn <i>(0.5% of EU GDP)</i>
Additional employment††	33,000 – 34,000 <i>(~0.01% of EU employment)</i>	242,000 – 310,000 <i>(~0.1% of EU employment)</i>	653,000 – 790,000 <i>(~0.4% of EU employment)</i>

Source: FTI Consulting analysis

Note: †Through the use of IO tables, government spending is earmarked to R&D and clean technology. All member states are assumed to provide state aid.

†† Employment impact was estimated using two methods: assuming a constant ratio of GDP/employment and back calculating the increase in labour remuneration as a result of increased GDP and the number of employees corresponding to the given remuneration.

Our findings suggest that benefits will likely outweigh the costs of abolishing the carbon leakage sectors' exemptions

Costs of carbon leakage		Benefits of abolishing CL exemptions		Commentary
Ineffective ETS, high compensation		Ineffective ETS, high compensation		Ineffective ETS, high compensation
GDP loss	€1.5 - 2.0 billion	GDP gain	€3.2 billion	<ul style="list-style-type: none"> ▪ The economy gains €3.2 billion in GDP (0.02% of the EU's total GDP) compared to the carbon leakage sectors' €1,5-2,0 billion GDP loss ▪ The net employment generation is between 11,000 -18,000 employees (~0.01% of the EU's total employment)
Employment loss	16,000- 22,000 employees	Employment gain	33,000 – 34,000 employees	
Moderately effective ETS, medium comp.		Moderately effective ETS, med comp.		Moderately effective ETS, med comp.
GDP loss	€7.0 - 9.5 billion	GDP gain	€22.6 billion	<ul style="list-style-type: none"> ▪ The economy gains €23billion in GDP (0.2% of the EU's total GDP) compared to the carbon leakage sectors' €7.0-9.5 billion GDP loss ▪ The net employment generation is between 137,000 – 234,000 employees (~0.1% of the EU's total employment)
Employment loss	76,000 – 103,000 employees	Employment gain	242,000 – 310,000 employees	
Effective ETS, no compensation		Effective ETS, no compensation		Effective ETS, no compensation
GDP loss	€17.5 – 23.6 billion	GDP gain	€60.6 billion	<ul style="list-style-type: none"> ▪ The economy gains €61 billion in GDP (0.5% of the EU's total GDP) compared to the carbon leakage sectors' €17,5-23,6 billion GDP loss ▪ The net employment generation is 398,000 – 601,000 employees (~0.3% of the EU's total employment)
Employment loss	189,000 – 255,000 employees	Employment gain	653,000 – 790,000 employees	

Source: FTI Consulting analysis

Note: Ineffective ETS assumes 34% auctioning and €5 EUA, Moderately effective ETS assumes 70% auctioning and €20 EUA and Effective ETS assumes 100% auctioning and €40 EUA. Government spending assumed to be earmarked for R&D and cleantech. All countries assumed to provide state aid at 77.5% intensity

Context and motivation for the project

Policy context:

EC 2030 framework and structural reform of the ETS

European Commission Green Paper
(COM(2013) 169 final) - "A 2030 framework
for climate and energy policies"

- *"One of the fundamental objectives of EU energy policy is to ensure that the energy system contributes to the competitiveness of the EU economy by ensuring competitive domestic and international energy markets and prices which are internationally competitive and represent affordable energy for final consumers."*
- *This is especially important for vulnerable households and industry sectors that are exposed to international competition and for which energy is an important production factor."*

2013 Member States Competitiveness
Performance and Implementation of EU
Industrial Policy report (September 25th)

- *"High energy prices are one of the factors contributing to the de-industrialisation process, as prices being high by global comparison."*
- *As Member States rely on various fuel mixes and different infrastructure, electricity prices for industrial consumers vary considerably across the EU."*
- *Most of the consistent performers have below-average electricity prices."*

Consultation on ETS structural
measures – DG CLIM rumored to favor
the following approach:

- Legislation for a new linear factor from 2020 coherent with the 80% by 2050 goal
- Legislation to establish a permanent supply management mechanism
- Extend the current carbon leakage list to 2030
- Create a new 900 million EUA fund similar to the NER300, dedicated to supporting low-carbon adjustment in energy intensive industries.



- In May 2013 the European Council asked the Commission to study the development and implications of energy prices and costs in Europe
- October 1st conference to inform cross department research initiative on the composition and drivers of energy prices and costs in Member States, in particular the part on the impact on energy intensive industries and SMEs, and looking more widely at the EU's competitiveness vis-à-vis its global economic counterparts
- February 2014: European Council dedicated to the issue of competitiveness and growth will discuss the competitiveness challenges that industry faces because of EU policies on energy, climate, research and trade

The EU ETS covers greenhouse gas emissions of power plants, manufacturing sectors and airlines

	ETS Phase 1	ETS Phase 2	ETS Phase 3
Period	2005-2007	2008-2012	2013-2020
Emission covered	CO ₂ 40% of total emissions in 24 EU countries	CO ₂ + N ₂ O + PFCs (27 EU + Iceland, Lichtenstein and Norway)	CO ₂ + N ₂ O + PFCs + others 45% of total emissions in 31 countries (28 EU + Iceland, Lichtenstein and Norway)
Sectors covered	<ul style="list-style-type: none"> Power plants Manufacturing sectors 	<ul style="list-style-type: none"> Power plants Manufacturing sectors Airlines from 2012 	<ul style="list-style-type: none"> Power plants Manufacturing sectors Airlines
Cap and Factor of Reduction	National Allocation Plans (NAPs) that fixed the cap and determined sectoral allocation		EU-wide cap (set in July 2010): <ul style="list-style-type: none"> 2.04 billion allowances in 2013 Reduction Factor = 1.74% CAGR
Allowance distribution	Free permits, max. 5% auctioned	<ul style="list-style-type: none"> Power plants - 90% free permits, rest auctioned Manufacturing sectors and airlines – free permits 	<ul style="list-style-type: none"> Power generators – 100% auction Manufacturing sectors and airlines: <ul style="list-style-type: none"> Non-carbon leakage sectors: 80% free in 2013 – 30% free by 2020 (at benchmark level), rest auctioned Carbon leakage sectors: 100% free (at benchmark level)
Allowance transfer to next phase	Not allowed	Allowed	Allowed
Carbon price	Maximum price: ~€30 Minimum price: €0	Maximum price: ~€30 Minimum price: <€3	Maximum price: ~€6 Minimum price: ~€3 (up to August 2013 – ICE EUA futures)

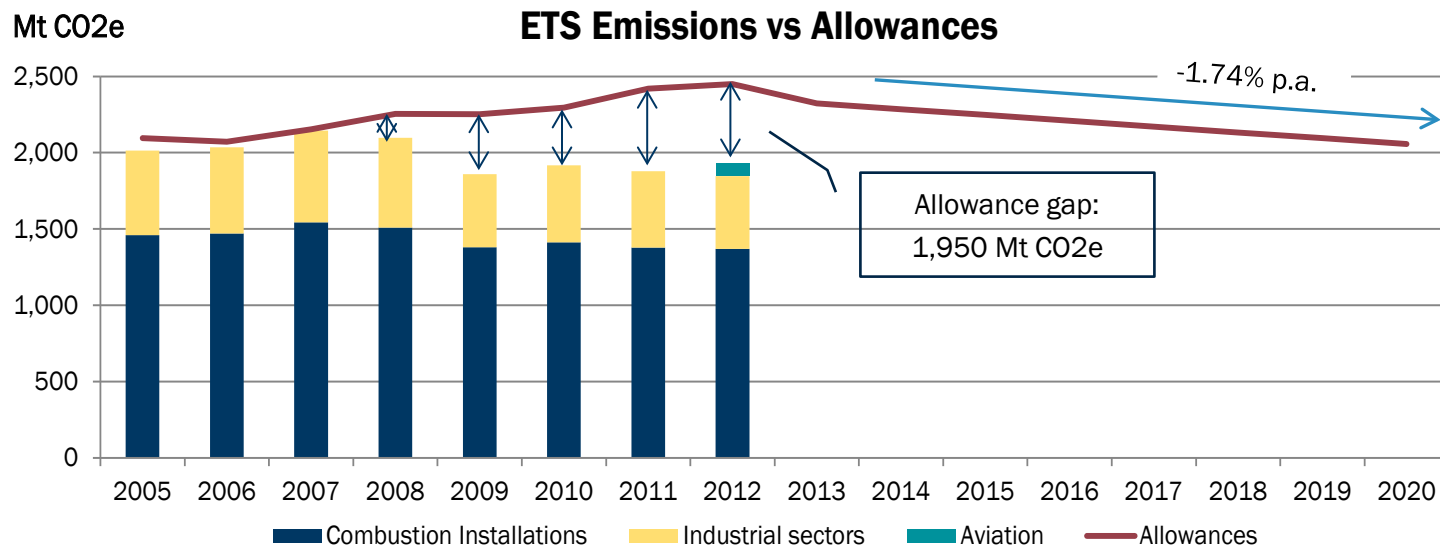
Emissions of the manufacturing sectors are ~ 30% of the power generation sector

Allowances and emissions in the 3 Phases of the ETS

- During Phase 1 and Phase 2, allowances **increased** from 2.1 billion EUA in 2005 to 2.45 billion EUA in 2012. This was due to the allocation of EUAs to new installations.
- Largely due to the recession, supply of allowances significantly exceeded demand in Phase 2. Currently there are approximately 1,950 million un-surrendered allowances brought forward from the second phase
- In Phase 3, the cap is going to be reduced by 1.74% p.a., from 2.3 billion EUA in 2013 to 2.0 billion EUA in 2020

Relative share of sector groups in emissions

- In 2012 combustion installations emitted 1.4 billion tonnes of CO₂, the industrial groups emitted 475 million tonnes of CO₂ and the aviation sector emitted 85 million tonnes of CO₂. The three groups' respective shares in emission were 71%, 25% and 4%.



Source: CITL, EU

COMPASS LEXECON

As the ETS moves toward increasing auctioning of allowances in Phase 3 the EU addresses the issue of carbon leakage

CARBON LEAKAGE ISSUE

What is carbon leakage?

Carbon leakage is the situation when for reasons of costs related to climate policies production is transferred to countries which have laxer constraints on greenhouse gas emissions.

How does the ETS impact firm competitiveness?

The ETS impacts firms' competitiveness vis-à-vis firms operating in countries without climate policies through two channels:

- Direct carbon costs – firms need to purchase and surrender allowances to cover their carbon emissions
- Indirect carbon costs – firms pay higher electricity prices as power generators pass on the carbon costs to downstream consumers

How does the EU assess carbon leakage?

The EU has developed a framework of quantitative and qualitative criteria to assess the increased costs and the trade intensity of sectors.

Carbon leakage lists – 2013-2014 and 2015-2019

Based on the carbon leakage assessment framework the EC developed a list of carbon leakage sectors in 2009 that is valid for the 2013-2014 period. A revised list for the 2015-2019 period is to be finalized in 2014.

EU MEASURES TO ADDRESS CARBON LEAKAGE

Exemptions of carbon leakage sectors

The sectors deemed exposed to a significant risk of carbon leakage receive the following exemptions:

- Carbon leakage sectors continue to receive **free allowances** in Phase 3 (up to a benchmark and considering the sectoral constraints)
- Additionally, they may obtain **financial compensation** through national state aid schemes for increases in electricity costs resulting from the ETS

The EU assesses exposure to carbon leakage through quantitative and qualitative criteria

Quantitative Criteria

A sector is deemed to have a sufficient exposure to carbon leakage if it passes at least one of three quantitative criteria:

1. Joint Carbon Cost – Trade Intensity

Production costs would increase by at least 5% of GVA (Gross Value Added), AND

The sector's trade intensity is greater than 10%

2. Carbon Cost only

The increase in production costs is greater than 30%, as a proportion of Gross Value Added

3. Trade Intensity only

The intensity of trade is greater than 30%.

Qualitative Criteria

A more detailed analysis based on the following criteria:

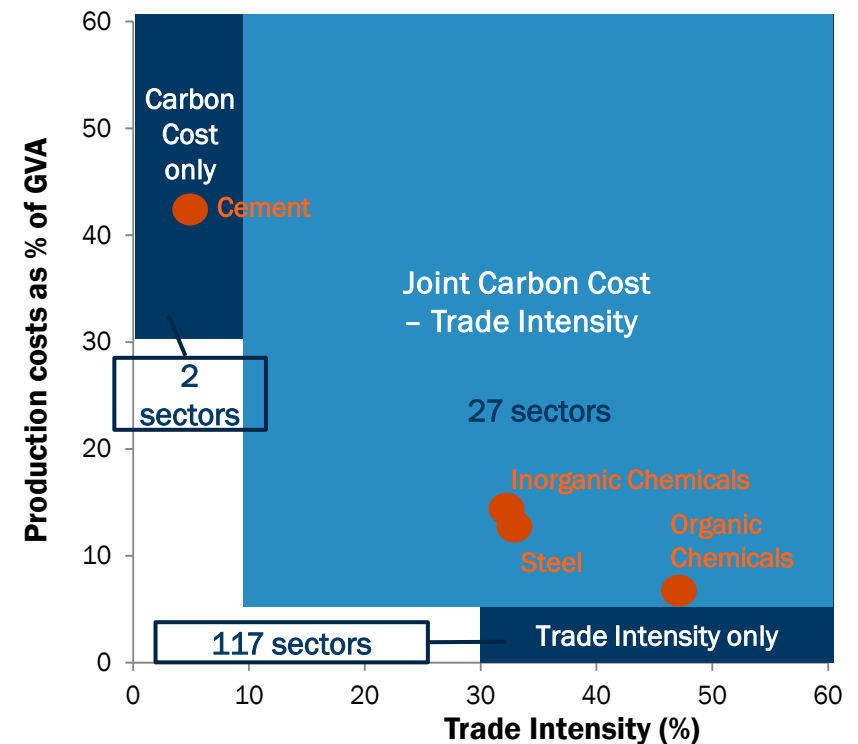
- The extent to which it is possible to reduce emission levels or consumption of electricity;
- Current and projected market characteristics; and
- Profit margins as an indicator of long-run investment or relocation decisions

Carbon Leakage List

164 sectors are on the Carbon Leakage list:

- 2 sectors are in the carbon cost only group;
- 27 sectors are in the joint group
- 117 sectors are in the trade intensity group
- 13 sectors qualify at sub-NACE 4 level
- 5 sectors qualify on qualitative criterion

Carbon leakage sector groups by assessment criteria



In 2005-06, the carbon leakage sectors emitted 95% of all industrial emissions

Carbon leakage sector characteristics

- There are 258 manufacturing sectors covered in the ETS
- Of the 258 manufacturing sectors, 162 sectors are on the carbon leakage list for 2013-14. These sectors receive free permits (up to benchmarks)
 - The 162 carbon leakage sectors produce 95% of total industrial emissions
- The vast majority of the sectors only qualify on the Trade Intensity criteria

Emissions of carbon leakage sectors vs. all manufacturing sectors, 2005-2006			
Reason for inclusion on CL list	Number of sectors	Verified emissions* (thousand tCO2)	% of industrial emissions
1. Joint carbon cost and trade intensity	13	219,303	36%
2. Carbon cost only	2	177,573	29%
3. Trade intensity only**	133	157,233	26%
4. Qualitative assessment	6	14,436	2%
NACE 6 and beyond***	8	5,779	1%
Total carbon leakage emissions	162	574,323	95%
Total industrial emissions	258	604,955	100%

Source: Delft, 2013

Notes:

* Average of 2005 and 2006 verified emissions

** Sixteen sectors that fall under Trade intensity only would also qualify for Joint carbon cost and trade intensity

*** Maximum estimate of emissions of 16 sectors belonging to 8 sectors at the NACE 4 level

The top emitters are steel, cement and chemicals - according to the free allocations published by the EC in 2013

Industry	Free allocations 2013-2020 (m EUAs)	% of total	Carbon leakage criterion
Basic iron and steel	1,512	23%	Joint criteria
Cement	1,110	17%	Carbon cost
Basic chemicals (including fertilizers)	998	15%	Various criteria
Refinery products (including coke)	878	13%	Joint criteria
Pulp and paper	247	4%	Trade intensity
Lime	202	3%	Carbon cost
Extraction of crude and natural gas	176	3%	Trade intensity
Ceramics (including bricks and tiles)	140	2%	Trade intensity and Joint criteria
Non-ferrous metals	129	2%	Trade intensity
Glass	121	2%	Joint criteria
Manufacturing total	6,600	100%	

Source: European Commission, October 2013

Carbon leakage group	Percentage of free allocations 2013-2020
Carbon cost	20%
Joint criteria	45%
Trade intensity	27%
Sub-NACE-4 level	1%
Qualitative	2%
Total CL	95%

Source: FTI Consulting estimates based on EC published allocations for 2013-2020 and Delft "Carbon Leakage and the Future of the EU ETS market", 2013

Note: Due to lack of data, allocation estimates for the trade intensity and the joint criteria groups could have a significant margin of error (a magnitude of 5-10% points). We have run sensitivities to understand the impact of such difference on the analyses and the conclusions remain the same in the different scenarios.

Allocated free allowances have consistently exceeded emissions for the manufacturing sector

Net allowance position of the sector groups

- Freely allocated allowances exceeded manufacturing emissions throughout Phase I and Phase II
- The power generation sector has been a net buyer of allowances since 2006
- The aviation sector finished its inaugural year with a net surplus in 2012
- The overall surplus expanded rapidly throughout Phase II

Carryover from Phase II to Phase III

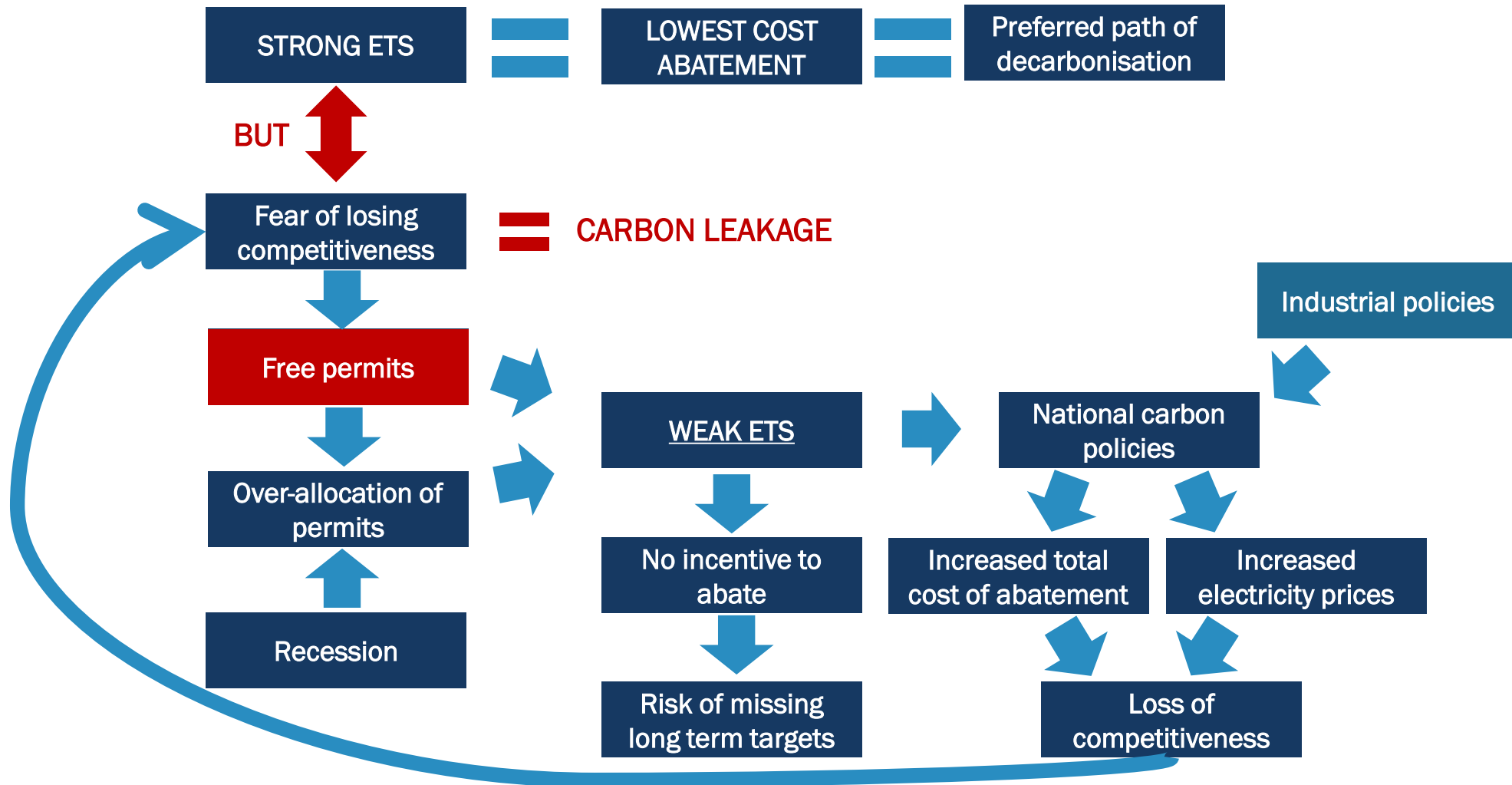
- The net carryover of 356 million EUAs to Phase III excludes effect of ERUs/ CERs (non-EU emissions credits)

Net freely allocated allowance position by sector group

Net position - Mt CO ₂	2005	2006	2007	Phase I Total	2008	2009	2010	2011	2012	Phase II Total
Manufacturing	73	60	56	189	92	205	185	190	218	890
Combustion	9	-25	-47	-63	-253	-114	-127	-77	-41	-612
Aviation	0	0	0	0	0	0	0	0	78	78
Total/Net Surplus	82	36	9	126	-161	91	58	113	256	356

Source: CITL

The interplay of carbon prices and economic competitiveness – a vicious circle



The interplay of carbon prices and economic competitiveness – identifying key issues

■ Quantifying the impact of carbon and energy costs on competitiveness

■ The debate on the impact of the costs of carbon and energy and competitiveness has been focused on a narrow list of sectors

- But competitiveness is a whole economy issue: costs on some sectors have to be weighted against the benefits in other parts of the economy
- This study complements existing literature by modeling the aggregate economic effects of carbon and energy prices

■ The policy discussions on competitiveness have been focused on production costs

- This study introduces a framework to identify the different drivers of competitiveness in a given sector
- A number of in depth case studies (steel, cement, chemicals) explore the impact of carbon and energy costs as well as the other drivers of competitiveness in these sectors

■ Intra European policy design issues

■ There are intra European policy issues of two kinds at the nexus of carbon and energy costs and competitiveness

- Differential approaches in national policies result in higher total costs of carbon abatement and higher energy prices
- Different approaches to pass through the costs of decarbonization to the sectors of the economy introduce distortive effects

■ The study makes contributions to both issues through the modeling of:

- The costs and benefits of spreading the costs of decarbonization on a wider sectorial base
- The benefits of using the ETS as the main driver of decarbonization through lower total abatement costs and lower electricity prices

Key sources

Topic	Reference	Key contribution
Costs and competitiveness	<ul style="list-style-type: none"> International Energy Agency, World Energy Outlook, 2013 World Energy Council (2013) Energy for Germany 2013 IHS. The challenge to Germany's global competitiveness in a new energy world European Commission, 2013-2030 Framework Impact Assessment, 2013 European Commission (2013) Stronger European industry for growth and economic recovery. Oberndorfer U, Rennings K (2007) Costs and competitiveness effects of the European Union emissions trading scheme. European Environment 17(1):1-17 Wuppertal Institute (2013) The impact of electricity demand reduction policies on the EU-ETS: Modelling electricity and carbon prices and the effect on industrial competitiveness Fortum, To combine decarbonisation and competitiveness, 2013 	<ul style="list-style-type: none"> Gas and electricity prices are significantly higher in the EU than in US and Asia. Gap is expected to persist. EU is projected to lose export market share of energy-intensive products <ul style="list-style-type: none"> EU end-user energy prices increase (due to renewables costs) despite declining whole-sale prices EU industry has lost competitiveness. Key problems: lack of investments, market opportunities, access to finance and skilled human capital The effects of the ETS on cost and competitiveness are modest Complementary policies (e.g. energy efficiency targets) reduce effectiveness of the ETS if the fixed cap is not adjusted
No leakage except for a small number of sectors argument	<ul style="list-style-type: none"> Delft (2013) Carbon Leakage and the Future of the EU ETS Market Dröge, S. and Cooper, S. (2010): Tackling Leakage in a World of Unequal Carbon Prices. A study for the Greens/EFA Group. Climate Strategies. May 2010. Carbon Trust (2010): Tackling carbon leakage: Sector-specific solutions for a world of unequal carbon prices Carbon Trust (2007): EU ETS Impact on Profitability and Trade. A sector by sector analysis Ellerman, Convery, de Perthuis (2010) Pricing Carbon, Ch.8 on competitiveness effects of ETS 2005-2008 Sartor (2012) Carbon Leakage in the Primary Aluminium Sector: What Evidence after 6.5 Years of the EU ETS? CDC Climate Research. Working Paper No 2012-12. 	<ul style="list-style-type: none"> List of carbon leakage sectors is too long <ul style="list-style-type: none"> Using updated and more realistic assumptions the vast majority of sectors should be removed from the carbon leakage list Out of 159 UK manufacturing activities studied, only a few are potentially exposed to carbon leakage (notably, steel, cement and some chemicals) Ex post studies find no impact of CO2 prices on trade flows of examined sectors
Counter-arguments on leakage	<ul style="list-style-type: none"> Ex-post study: Aichele et al (2011) Kyoto and Carbon Leakage: An Empirical Analysis of the Carbon Content of Bilateral Trade, CESifo Several ex-ante studies: e.g. Ponssard, J.P. and Walker, N. (2008): EU Emissions Trading and the cement sector: a spatial competition analysis, Climate Policy (2008) Volume: 8, Issue: 5, Earthscan, 467-93 	<ul style="list-style-type: none"> One ex-post study found that imported carbon content increased during the first two phases of the ETS Ex-ante studies predicted significant carbon leakage at high carbon prices and without mitigation efforts
Over - allocation and windfall profits in the EU ETS	<ul style="list-style-type: none"> Greenstream (2013): Oversupply and structural measures in the EU ETS. Sijm, Neuhoof, Chen (2006) CO2 Cost Pass Through and Windfall Profits in the Power Sector, Climate Policy Trotignon, R., & Delbosc, A. (2008). Allowance trading patterns during the EU ETS Trial Period : what does the CITL reveal ? Mission Climat, Caisse des Dépôts Pearson, A. (2010). The Carbon Rich List: the companies profiting from the EU Emissions Trading Scheme. Sandbag Climate Campaign, UK. Sandbag (2011). Carbon fat cats. The companies profiting from the EU Emission Trading Scheme Smale et al (2006) Free allocation and carbon leakage risks for UK industry, Climate Policy 	<ul style="list-style-type: none"> Factors behind the oversupply of the ETS are the recession, overlapping policy instruments, international credits, influence of individual member states In the early phases of the ETS electricity companies passed on the costs of free permits and generated windfall profits The manufacturing sectors have been consistently over-allocated



Additional key sources

Topic	Reference	Key contribution
Macroeconomic shock	<ul style="list-style-type: none"> Burriel, P. et al. (2010). "Fiscal policy shocks in the euro area and the US: an empirical assessment". <i>Fiscal Studies</i> 31(2), 251–285. Arpaia, Roeger et al., 2007, "Quantitative assessment of structural reforms: modeling the Lisbon Strategy", European Commission. 	<ul style="list-style-type: none"> An increase in net taxes (including taxes on capital) has an overall multiplier effect of -0,5 in Europe. Suggests that a rise in R&D spending of 1,1% of GDP in Europe would trigger an upward effect on GDP of slightly less than 2,6
GDP multipliers	<ul style="list-style-type: none"> Nickell S., et R.Layard (1999), "Labor market institutions and economic performance", in O.Aschenfelter and D.Card (eds), <i>Handbook of Labor Economics</i>, vol 3., (Amsterdam, North Holland). Nickell S. (2004), "Employment and taxes", Centre for economic performance discussion paper n° 634, London School of Economics. Cahuc P. et A.Zylberberg (2001), <i>Le marché du travail</i>, De Boeck. Rosen H. (2001), <i>Public finances</i>, McGraw Hill. Klein C. and O.Simon, "Le modèle Mésange réestimé en base 2000", G2010/3, INSEE, Paris Barrell, R., D. Holland and I. Hurst (2012), "Fiscal Multipliers and Fiscal Consolidations", <i>OECD Economics Department Working Papers</i>, No. 933 Ramey, Valerie, feb 2011, "Identifying Government Spending Shocks: It's All in the Timing", <i>Quarterly Journal of Economics</i> Mulkay et Mairesse (2004), « Une évaluation du crédit d'impôt recherche en France (1980-1997) », <i>Revue d'Économie Politique</i>, n° 114(6) 	<ul style="list-style-type: none"> Provides with estimates of the elasticity of labour supply to its cost Provides with aggregate effect on GDP of shocks on labour cost, and shocks on public investment. Finds that expenditures multipliers in France and Germany are, broadly speaking, twice as much as tax multipliers Find that the multiplier for military expenditures in high tech have a 1,5 multiplier effect. Find that 1€ of tax expenditures fostering R&D increase total R&D by 3€ to 4,6€, including 2€ to 3,6€ from the private sector.

Proposed modelling approach: a cost-benefit analysis

Costs of phasing out Carbon Leakage exemptions

- If the carbon leakage sectors' exemptions were phased out, they would incur (additional) direct and indirect carbon costs
- Some of this ETS cost would be passed on to consumers depending on the sectors' ability to increase prices without a significant loss in demand for their products

Benefits of phasing out Carbon Leakage exemptions

- If carbon leakage sectors' exemptions were phased out the government would generate revenues from the auctioned carbon permits and save the state aid that would otherwise be given to the CL sectors. These revenues would be recycled to the economy increasing GDP and employment
- Additionally, more optimal abatement would result in lower carbon and electricity prices benefiting households and businesses alike

*Strong connection
between costs
and benefits*

Costs:

- 1.) Direct cost = Emissions * carbon price (€/ton)
- 2.) Indirect cost[†]
- 3.) Volume impact from passed on costs

Benefits:

- 1.) Government revenue = Emissions * carbon price (€/ton)
- 2.) State aid savings = Indirect cost[†]

Net effect will depend on:

The ability of sectors to pass on some costs and the elasticity of demand
Employment and GDP generation ability of the economic segments where government revenue is channelled to

Note:

[†] Indirect costs are a result of the power generation sector passing on the cost of carbon to electricity users. Not all indirect costs qualify for compensation

We modelled 9 scenarios

Baseline scenario assumptions:

- The carbon price is €14/tonne CO₂ (the average during Phase I and Phase II of the ETS)
- CL sectors receive 100% of their EUAs for free, no compensation for indirect costs
- The CL sectors' volume, price, turnover and profit are at an 'average' level (2003-2010 average)

Removing CL sectors' exemptions – scenarios:

Carbon prices:

- €5 / tonne of CO₂ = “Ineffective ETS”
- €20 / tonne of CO₂ = “Moderately effective ETS”
- €40 per tonne of CO₂ = “Effective ETS”

Auctioning percentages:

- 34% (as applies to the non-CL manufacturing sectors in 2015) = “ETS with high compensation”
- 70% (as applies to the non-CL manufacturing sectors in 2020) = “ETS with medium compensation”
- 100% (full auctioning) = “ETS with no compensation”

Carbon Price	Auctioning percentage		
	34%	70%	100%
€5 / tonne of CO ₂	Ineffective ETS with high compensation	Ineffective ETS with medium compensation	Ineffective ETS with no compensation
€20 / tonne of CO ₂	Moderately effective ETS with high compensation	Moderately effective ETS with medium compensation	Moderately effective ETS with no compensation
€40 / tonne of CO ₂	Effective ETS with high compensation	Effective ETS with medium compensation	Effective ETS with no compensation

The costs of removing exemptions for carbon leakage sectors

There are many drivers of competitiveness yet policy discussions have centred around production costs

Competitiveness in policy discussions have centred around production costs ...

- Policy discussions have focussed on the impact of carbon costs on the cost structure of EU producers
- For example, the Commission's criteria to include a sector on the Carbon Leakage list focus on production costs as a percentage of gross value add (as well as the trade intensity of the sector)

... however, there are many drivers of competitiveness that need to be considered

A good framework to analyse firm competitiveness and firms' ability to support climate related costs is Porter's 5 forces:

■ Intensity of rivalry:

- Strong rivalry reduces firms' ability to increase prices and pass on costs

■ Buyer power:

- Similarly, high bargaining power of buyers reduces firms' ability to raise prices and thus pass on carbon costs

■ Supplier power:

- Strong supplier power reduces firms' ability to manage costs and margins

■ Threat of new entrants:

- A profitable market attracts new firms which will intensify competition unless incumbents are able to block new entrants

■ Threat of substitutes:

- The availability of close substitute products (import can also be interpreted this way) reduces firms' ability to pass on carbon costs as buyers can switch to alternatives

This study combines:

- An extensive review of competitiveness of EU firms in selected sectors analysing the above drivers of competitiveness
- A detailed plant level production cost and profitability analysis

Porter's 5 forces is a good framework to analyse industry competitiveness

Policy discussions have focused on the impact of carbon costs on the cost structure of EU producers

Strong supplier power reduces firms ability to manage margins

- Supplier concentration
- Availability of substitute inputs
- Importance of suppliers' input to buyer
- Suppliers' product differentiation
- Importance of industry to suppliers
- Buyers' switching cost to other input
- Suppliers' threat of forward integration
- Buyers' threat of backward integration

High barriers to entry increase firms' market power

- Economies of scale
- Product differentiation
- Capital requirements
- Switching cost to buyers
- Access to distribution channels
- Government policies
- Incumbents' defence of market share
- Industry growth rate

Strong rivalry reduces firms' market power

- Number of competitors (concentration)
- Relative size of competitors (balance)
- Industry growth rate

Production costs

- Product differentiation
- Capacity augmented in large increments
- Buyers' switching costs
- Diversity of competitors
- Exit barriers

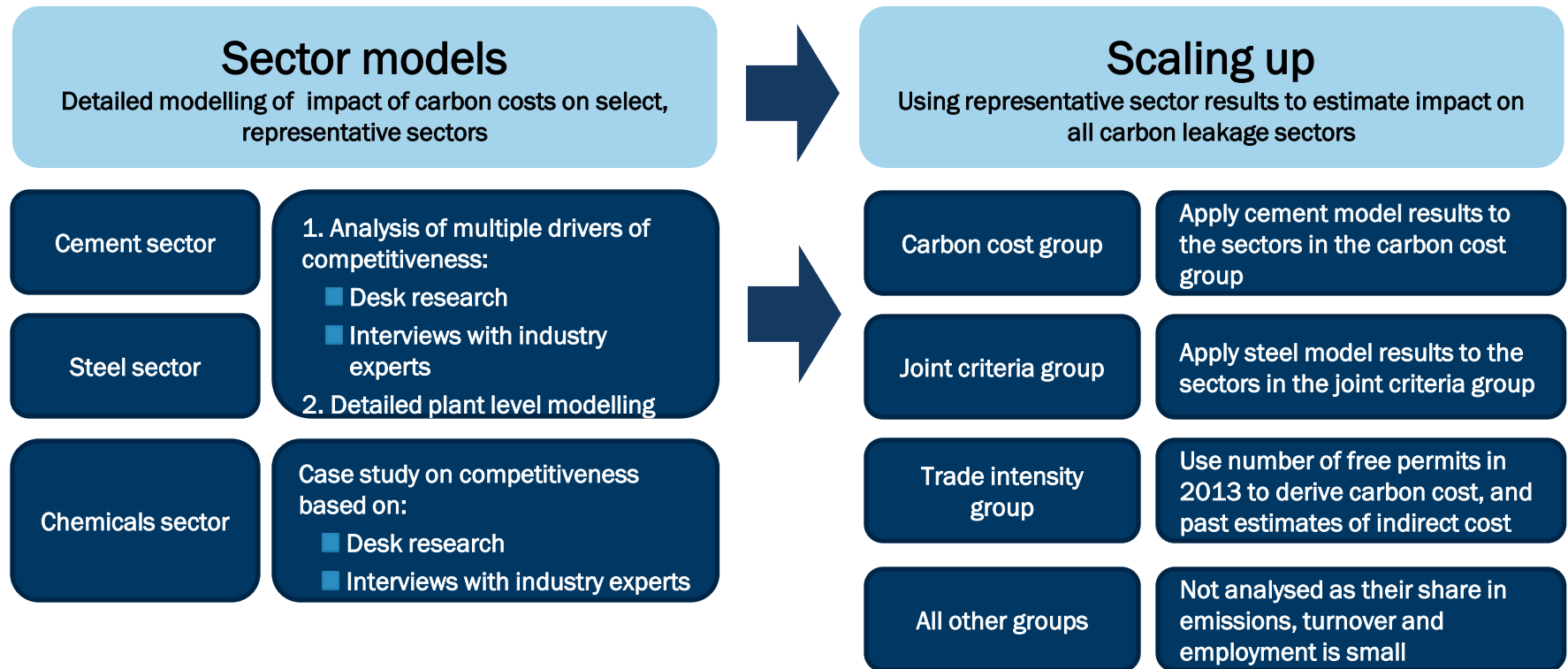
High threat of substitutes reduces firms' market power

- Relative price of substitute
- Relative quality of substitute
- Switching costs to buyers

Strong buyer power reduces firms' ability to raise prices and pass on costs

- Number of buyers relative to seller
- Product differentiation
- Switching costs to use other product
- Buyers' profit margins
- Buyers' use of multiple sources
- Buyers' threat of backward / forward integration
- Importance of product to the buyer
- Buyers' volume

We first modelled some representative sectors in detail and then used the results to scale up the costs for all CL sectors



Steel and cement sectors were chosen for detailed modelling; the chemicals sector is presented through a case study

Sector selection consideration

1. Representation of carbon leakage list:
 - Sectors are included in the list for different reasons (carbon cost, joint reason, trade intensity)
 - Sectors are representative of the other sectors that are on the list for the same reason
2. Homogeneity of sector – ease of modelling
3. Data availability
4. Sector coverage of relevant reports

Sector	Reason for CL threat	Representative of its group	Homogeneity of sector	Data availability	Report coverage	Model?
Cement	Carbon cost	Yes	Very homogeneous	Good data	Older reports on ETS impact	✓
Steel	Carbon cost + trade intensity	Yes	Fairly homogeneous	Good data	Recent reports on ETS impact	✓
Chemicals	Various, depends on product	No	Very heterogeneous	Not all data publicly available	Some older reports on ETS impact	CASE STUDY

Steel sector analysis

Removal of exemptions would impact BOF and EAF plants differently

Carbon costs and competitiveness

- The steel industry is suffering from overcapacity and as a result from very strong intra-European competition. Import substitution is a secondary issue
- Part of steel production is carbon intensive but not energy intensive and the other part is energy intensive but not carbon intensive
 - 43% of production is with EAF technology that hardly emits carbon but is energy intensive
 - 57% of production is with BOF technology which is carbon intensive but significantly less energy intensive
- EU producers are the highest cost producers. Carbon costs would increase production costs significantly for BOF producers but not for EAF producers
- There are important barriers to import substitution and relocation
 - Barriers to import substitution include switching costs, qualification process, standards, transport costs, etc.
 - There are very few examples of successful relocation and few regions where relocation could be economical

Impact of removing Carbon Leakage exemptions

- Steel plants have been operating at low long term EBITDA margin levels due to overcapacity and strong intra-EU competition. Attempts to take out capacity have been met with political resistance
- EAF and BOF plants are facing very different risk of carbon leakage
- The impact of auctioning and indirect costs:
 - The impact on EAF plants is less than 2% point of EBITDA even at full auctioning and high carbon prices (€40)
 - The impact on BOF plants is significantly larger driven by their high emission intensity and not by their energy intensity. The fall in EBITDA margin remains under 2% point if
 - carbon prices remain low (€5/tonne of CO₂). In this case even full auctioning would not lead to higher than 2% point loss in EBITDA margin
 - carbon prices are at medium level (€20/tonne of CO₂) but auctioning percentage remains low (at 34% level)

While the steel sector is facing strong intra-EU competitive pressures there are important barriers to import substitution

- Factors strengthening EU plants' competitiveness
- Factors neutral to EU plants' competitiveness
- Factors weakening EU plants' competitiveness

Strong supplier power

- High volatility of raw material prices demonstrates supplier power:

"Iron ore moved from \$35/ton 2004, to \$200/ton in 2008, then went back in 2009 to \$85 and bounced back in 2011 to \$200"
Steel industry expert

Important barriers to entry

- Economies of scale are extremely important for long term viability
- There are very high capital requirements
- Incumbents are ruthless in defending their market share
- There is significant overcapacity in the steel industry already

Strong rivalry within the EU

- High overcapacity: mills are trying to place some volume at all costs
- Relatively large number of competitors
- Part of production is differentiated but the other part is commodity
- Buyers' switching costs are lower for the commodity segment and higher for the specialty segment
- High capex is an important exit barrier

Buyer power is strong in the commodity but less so in the specialty segment

Specialty segment:

- Large buyers buy large volumes
- But qualification process and long term co-design relationship makes switching costly

Commodity segment:

- No product differentiation
- Price is key purchase criterion
- Switching costs are lower

Important barriers to import substitution

Although EU producers are the highest cost producers there are several barriers to import substitution:

- Imports are constrained by issues such as exchange rate volatility, lead time, working capital restrictions, lot sizes, serviceability, etc.

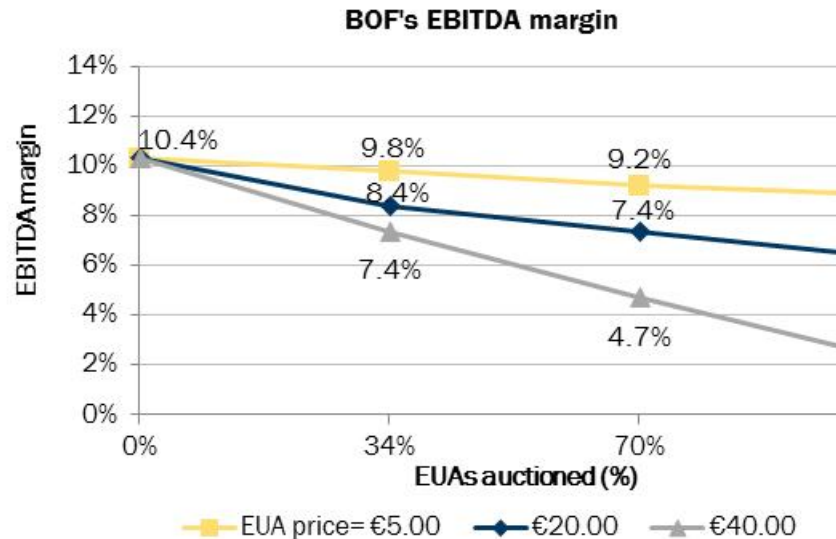
Specialty segment:

- OEMs have long term relationships with suppliers, switching costs are high
- EU has quality standards that few importers can meet

Commodity segment:

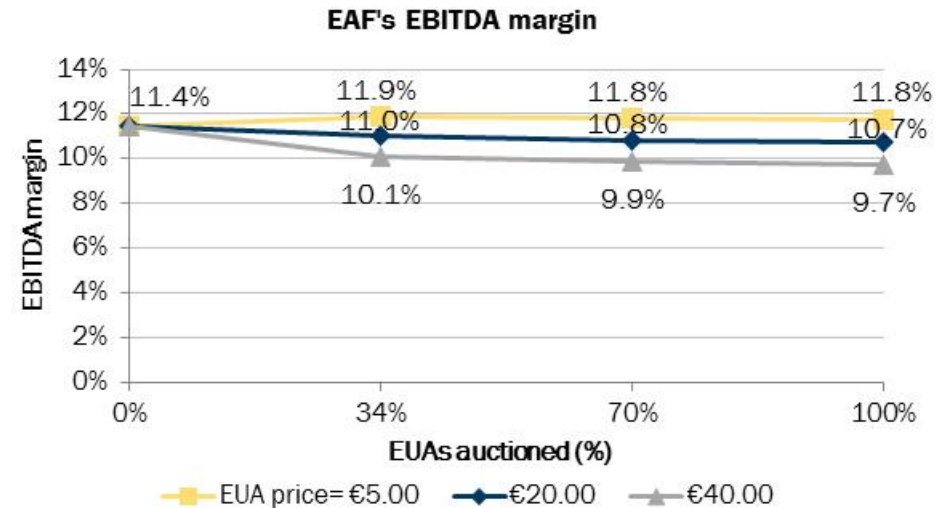
- Both volume and price of commodity orders are lower making transport costs significant

BOF plants are significantly impacted at higher carbon prices and auctioning, EAF plants are only marginally impacted



Impact of removing Carbon Leakage exemptions on BOF plants:

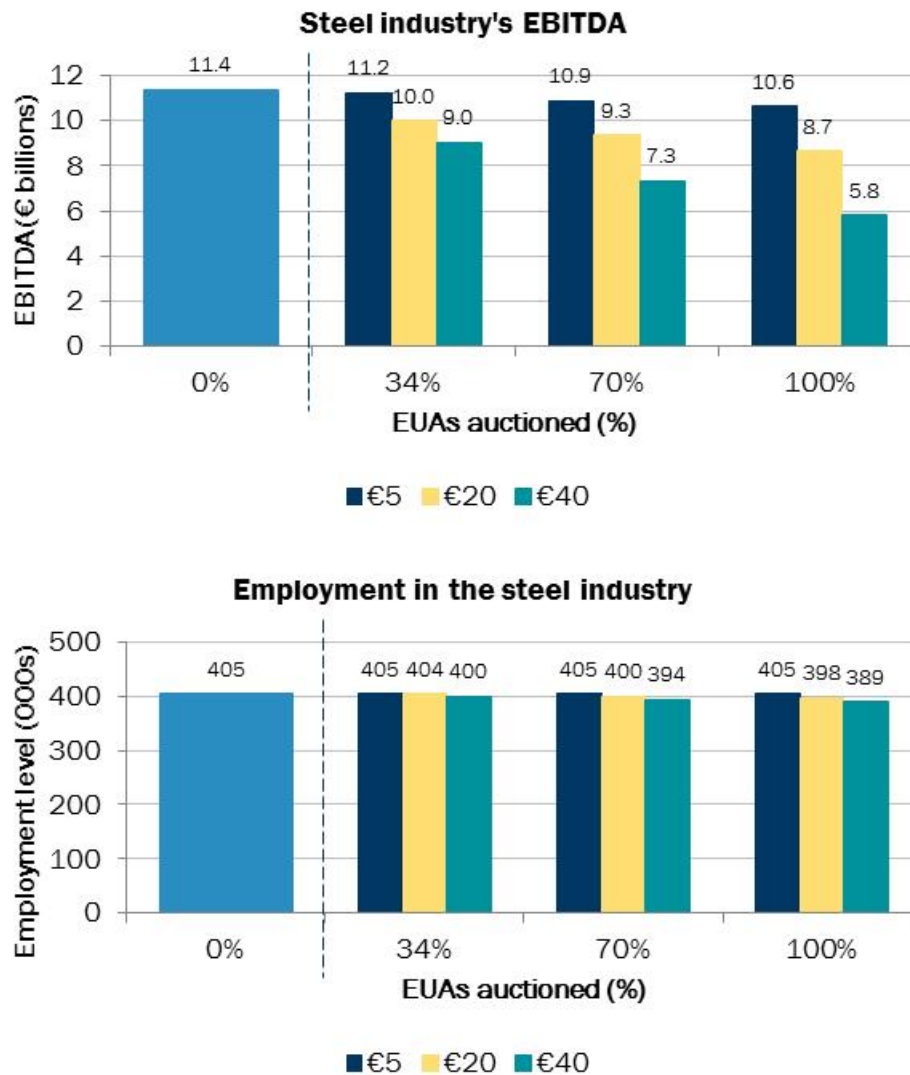
- BOF plants' EBITDA margin declines less than 2% point even at full auctioning if carbon prices remain at the €5 level
- In the effective ETS scenario with no compensation, BOF plants' EBITDA margin declines dramatically from 10% to 2%



Impact of removing Carbon Leakage exemptions on BOF plants:

- EAF plants' EBITDA margin improves at the €5 carbon price level. This improvement is driven by the lower carbon prices compared to the baseline (€14 EUA)
- In the effective ETS scenario with no compensation, EAF plants' EBITDA margin declines by less than 2% points

The impact of removing exemptions ranges from negligible to significant depending on carbon prices and auctioning 1/2



Source: FTI Consulting analysis

Long-term trend of declining employment levels and rationalisation at existing steel plants

- Employment levels have declined by 3% per year on average over the last ten years
 - With the number of plants declining at an average rate of 2% per year across the same period
 - Firms have been rationalising the staff numbers per plant. The number of employees per plant has been declining at a rate just above 1% per year over the last decade
- If carbon leakage exemptions were abolished the fall in EBITDA and employment would increase with the carbon price and the percentage of EUAs that are auctioned. For example:
- In the baseline scenario, the industry has an EBITDA of €11.4 billion, and employs 405,000 workers
 - At low carbon prices the impact on EBITDA and employment is €0.8 billion and the employment impact is negligible
 - At an auctioning rate of 70% with carbon prices at €20 the loss of EBITDA is €2.1 billion from the baseline, with the reduction in employment in the region of 5,000

The impact of removing exemptions ranges from negligible to significant depending on carbon prices and auctioning 2/2

Scenario (Carbon price - % auctioned)	EBITDA (€ bn)	EBITDA change c.t. baseline (€ bn)	EBITDA change c.t. baseline (%)	EBITDA margin (%)
Baseline	11.38			10.8%
€5 - 34%	11.23	-0.15	-1.3%	10.7%
€5 - 70%	10.87	-0.51	-4.5%	10.3%
€5 - 100%	10.62	-0.76	-6.7%	10.1%
€20 - 34%	10.01	-1.37	-12.0%	9.5%
€20 - 70%	9.34	-2.04	-17.9%	8.8%
€20 - 100%	8.67	-2.71	-23.8%	8.2%
€40 - 34%	9.04	-2.34	-20.6%	8.5%
€40 - 70%	7.34	-4.04	-35.5%	6.9%
€40 - 100%	5.80	-5.58	-49.0%	5.4%

Impact of removing Carbon Leakage exemptions on the overall EU steel industry including BOF and EAF plants:

- In the ineffective ETS scenario (with a carbon price of €5 and 34% auctioning), there is a small decline in profitability of €0.15 billion, or 1.3%, with a negligible impact on employment levels
- In the effective ETS scenario (with a carbon price of €40 and 100% auctioning), there is a more significant decline in profitability, with EBITDA falling by €5.58 billion, from a margin of 10.8% in the baseline to 5.4%. There is also a loss of employment of nearly 16,000 workers, representing 4% of the workforce

Scenario (Carbon price, % auctioned)	Employment (#)	Employment change c.t. baseline (#)	Employment change c.t. baseline (%)
Baseline	405,319		
€5 -34%	405,244	-75	0.0%
€5 - 70%	404,977	-342	-0.1%
€5 - 100%	404,608	-711	-0.2%
€20 - 34%	403,885	-1,434	-0.4%
€20 - 70%	400,213	-5,106	-1.3%
€20 - 100%	397,609	-7,710	-1.9%
€40 - 34%	399,947	-5,372	-1.3%
€40 - 70%	393,931	-11,388	-2.8%
€40 - 100%	389,475	-15,844	-3.9%

Source: FTI Consulting analysis

Cement sector analysis

Removal of exemptions would impact inland and coastal plants differently

Carbon costs and competitiveness

- The cement sector's production volume fell by 70% since 2007. However the industry managed to keep EBITDA margins at over 20% and European operators have among the highest margins globally
- The cement industry does not qualify for indirect cost compensation. Indirect costs in the cement sector are about 3% of production costs even at high carbon prices (€40)
- The industry will be significantly impacted if it did not get free permits but there are strong barriers to import substitution and relocation
 - EBITDA margins could decline by 0.5% point to 19% point depending on carbon prices and auctioning percentages
 - Inland operators would be significantly less impacted than coastal operators:
 - At high carbon prices and full auctioning the EBITDA margin of inland operators would stay close to 20%, that of coastal operators would fall to 2%
 - High transport costs, concentrated market structure and quality restrictions create barriers to import and relocation

Impact of removing Carbon Leakage exemptions

- The impact of auctioning varies significantly between coastal and inland operators:

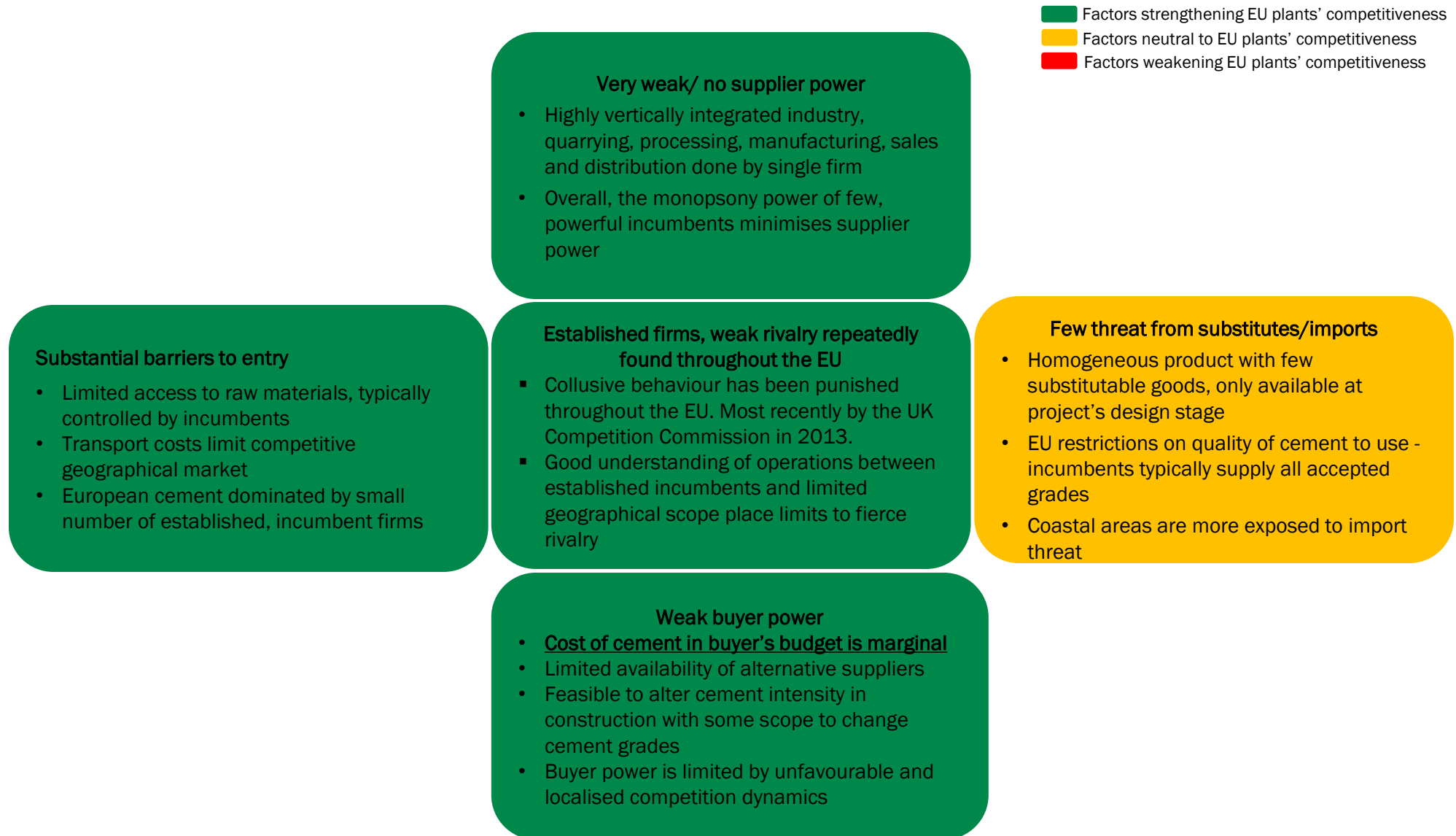
Inland operators

- Inland operators appear to have significantly higher margins than coastal operators
- The impact of auctioning on inland operators is negligible at low carbon price level (€5) even with full auctioning – less than 2% point of EBITDA
- The impact is significant at high carbon price levels (€40) and full auctioning – a fall of 13% point in EBITDA, however operators would retain close to 20% EBITDA margin even in this scenario

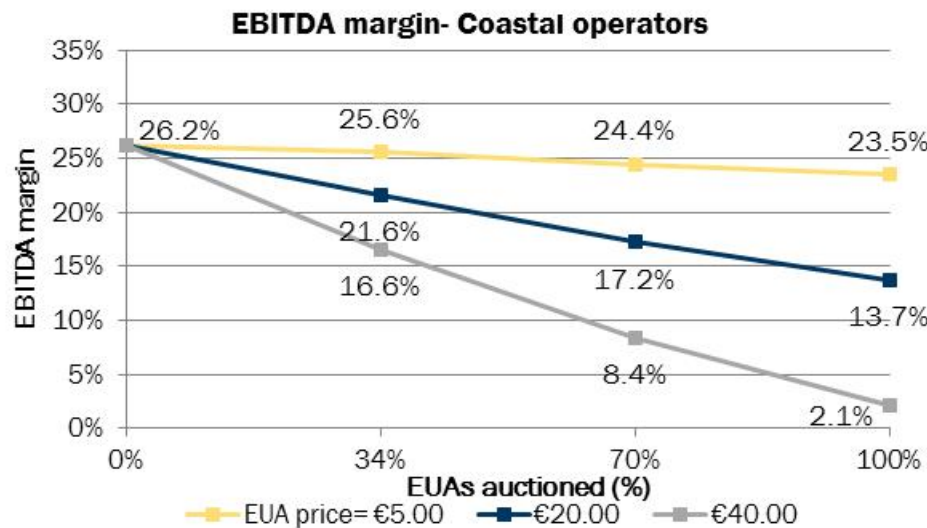
Coastal operators

- Coastal operators face larger threat of import substitution than inland operators
- The impact of removing exemptions on these operators would be marginal at low carbon prices (€5)
- At higher prices and auctioning levels the impact on margins becomes significant and EBITDA margins drop to 2% at €40 carbon prices and full auctioning

Cement sector competitiveness framework highlights significant market power of cement firms



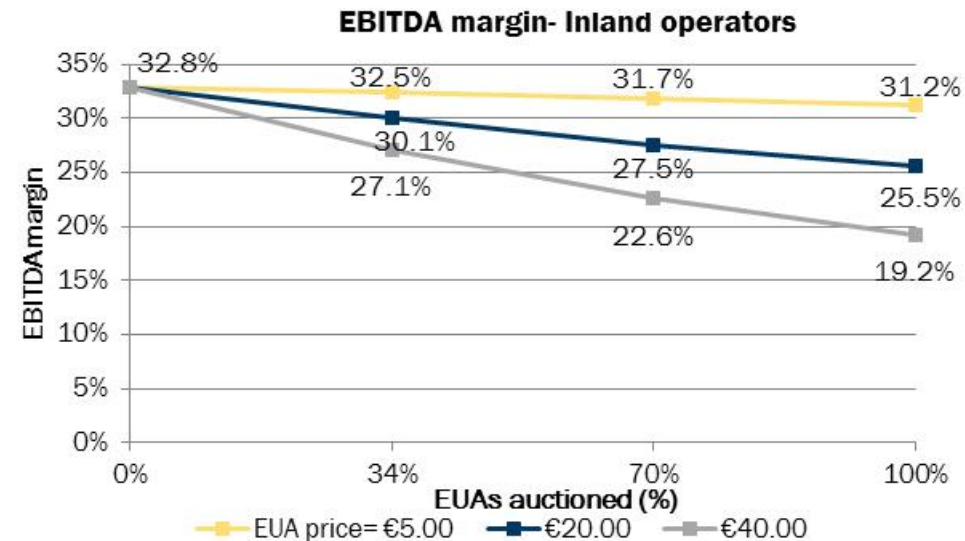
Coastal plants are significantly impacted at higher carbon prices, inland plants retain close to 20% EBITDA margins even in the strictest scenario



Source: FTI Consulting analysis

Impact of removing Carbon Leakage exemptions on coastal operators:

- Coastal operators' EBITDA margin declines less than 3% point even at full auctioning if carbon prices remain at the €5 per tonne level
- In the effective ETS scenario with no compensation, coastal operators' EBITDA margin declines dramatically from 26% to 2%

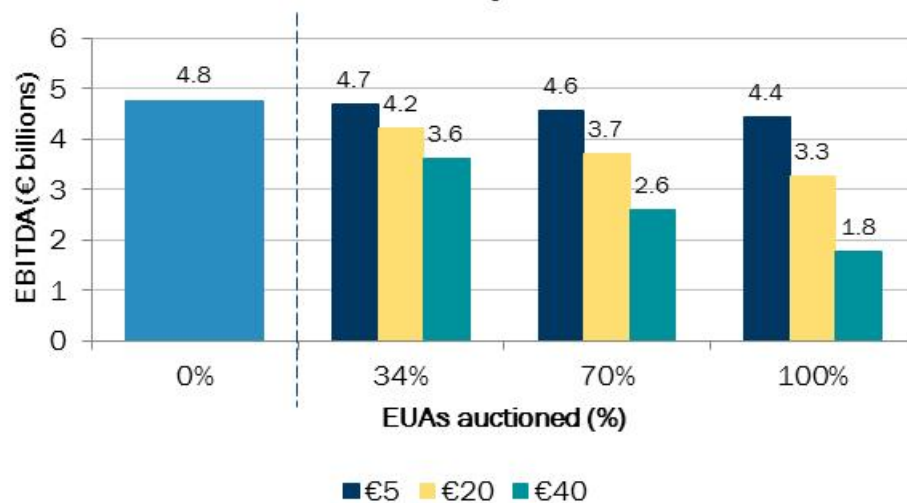


Impact of removing Carbon Leakage exemptions on inland operators:

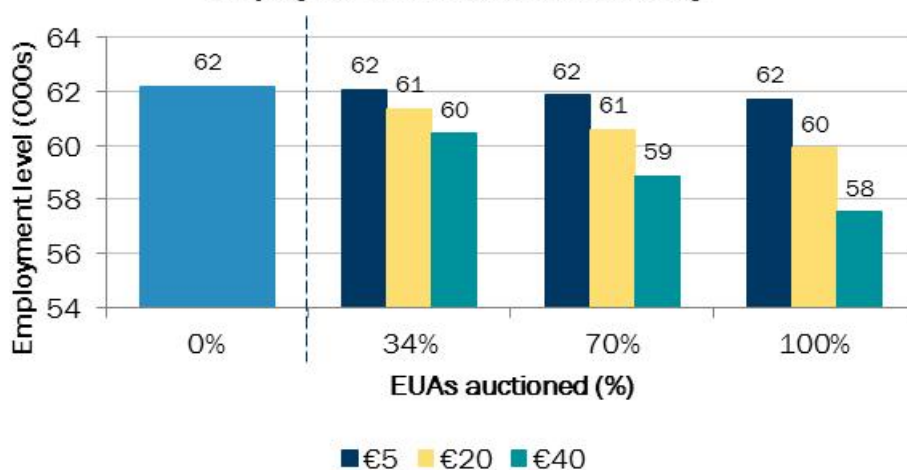
- Impact on inland operators' EBITDA margin is negligible at €5 per tonne carbon price level
- In the effective ETS scenario with no compensation, inland operators are significantly impacted (a fall of 13% point EBITDA) but are able to retain close to 20% margins

The cement industry as a whole – EBITDA and employment

Cement industry's EBITDA



Employment in the cement industry



Long-term trend of declining employment levels across the cement industry

- Employment levels have declined by 3.5% per year on average over the last ten years
- Our modelling results suggest that strengthening the ETS is likely to reduce profitability and employment levels in the cement industry
- The fall in EBITDA and employment increases with the carbon price and the % of EUAs that are auctioned. For example:
 - In the baseline scenario, the industry has an EBITDA of €4.8 billion, and employs 62,000 workers
 - At low carbon prices the impact on EBITDA and employment is small
 - At an auctioning rate of 70% with carbon prices at €20 the loss of EBITDA is €1.2 billion from the baseline, with the reduction in employment in the region of 1,000

Source: FTI Consulting analysis

The impact of removing exemptions ranges from negligible to significant depending on carbon prices and auctioning

Scenario (Carbon price, % auctioned)	EBITDA (€ bn)	EBITDA change c.t. baseline (€ bn)	EBITDA change c.t. baseline (%)	EBITDA margin (%)
Baseline	4.77			29.1%
€5, 34%	4.70	-0.07	-1.6%	28.5%
€5, 70%	4.56	-0.21	-4.4%	27.6%
€5, 100%	4.45	-0.32	-6.8%	26.8%
€20, 34%	4.23	-0.54	-11.4%	25.3%
€20, 70%	3.70	-1.07	-22.5%	21.7%
€20, 100%	3.26	-1.51	-31.6%	18.9%
€40, 34%	3.61	-1.16	-24.3%	21.2%
€40, 70%	2.59	-2.18	-45.7%	14.7%
€40, 100%	1.77	-3.00	-63.0%	9.8%

- In the ineffective ETS scenario (with a carbon price of €5 and 34% auctioning, there is a small decline in profitability of €0.07 billion, or 1.6%, with a negligible impact on employment levels
- In the effective ETS scenario (with a carbon price of €40 and 100% auctioning), there is a more significant decline in profitability, with EBITDA falling by €3 billion, from a margin of 29% in the baseline to 9.8%. There is also a loss of employment of over 4,600 workers, representing 7.4% of the workforce in the baseline

Scenario (Carbon price, % auctioned)	Employment (#)	Employment change c.t. baseline (#)	Employment change c.t. baseline (%)
Baseline	62,163		
€5, 34%	62,055	-108	-0.2%
€5, 70%	61,856	-306	-0.5%
€5, 100%	61,691	-471	-0.8%
€20, 34%	61,364	-799	-1.3%
€20, 70%	60,571	-1,591	-2.6%
€20, 100%	59,911	-2,252	-3.6%
€40, 34%	60,442	-1,720	-2.8%
€40, 70%	58,857	-3,305	-5.3%
€40, 100%	57,536	-4,626	-7.4%

Chemicals sector analysis

The chemical industry is strongly united when it comes to exemptions despite its obvious heterogeneity

Key arguments supporting Carbon Leakage exemptions

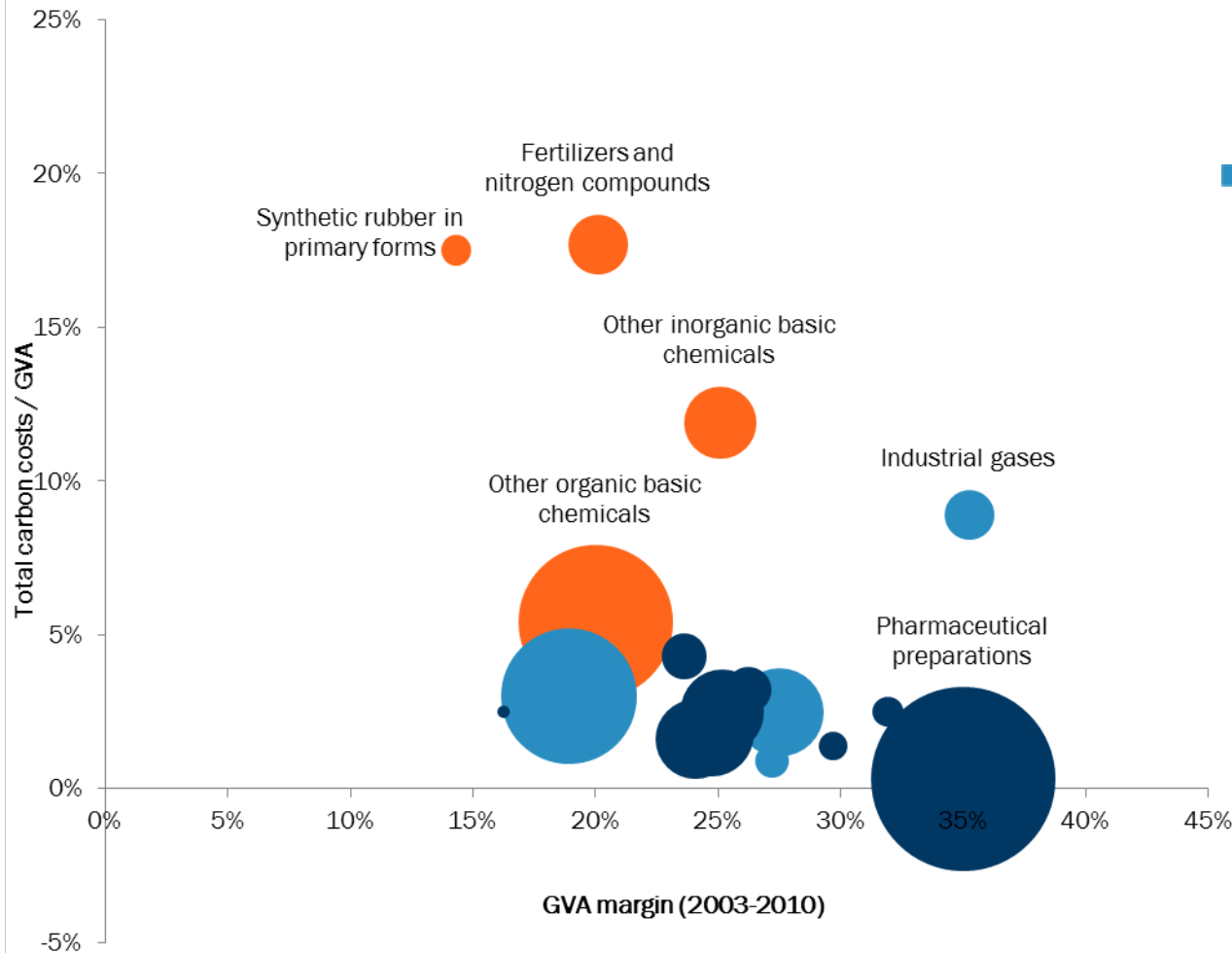
1. The whole chemicals industry has to be protected from carbon leakage
2. ETS will impose significant costs, up to 50% of gross margins
3. The chemical sector paid huge costs as a result of the ETS
4. The industry faces strong competitive pressures

Key findings of this report

1. 18 of the 20 NACE-4 chemical sectors receive exemptions. These sectors are extremely heterogeneous in terms of emission, energy and trade intensity, and profitability
 - For example, pharmaceutical preparations – by far the largest sector in terms of turnover – has practically no carbon costs and has one of the highest long term EBITDA margins in the industry
2. At a NACE-4 level, the cost of carbon is less than 20% of gross margin for every sector and less than 5% of gross margin for the majority of the sectors. Individual products may have higher carbon costs / GVA (in particular some petrochemicals) but these will be the exceptions rather than the rule
3. Analysis of select top chemical firms show an over-allocation of free permits between 10-66% in the chemicals industry
4. Some sectors of the industry , e.g. polyethylene production, face significant external competitive pressures, however this is a result of a host of factors. Other sectors face lower pressures, e.g. pharmaceutical preparations has maintained close to 20% EBITDA during 2003-10

The chemicals industry is very heterogeneous – there is no “one size fits all” solution

Chemicals carbon leakage sectors



■ Carbon costs as a percentage of margins and margins themselves are among the most important indicators of how a sector will be impacted by carbon costs

■ Chemicals carbon leakage sectors show a range of values for both these parameters

■ The chemicals sector had on average 26% GVA (gross) margin during 2003-2010, while its carbon costs/GVA averaged 5% (calculated with 75% auctioning of EUAs and an EUA price of €30)

— If the “average” chemicals sector had to pay for carbon permits, its gross margin is estimated to decline by 5%, i.e. from 26% to 22%

■ GVA margins for the sectors range from 14% for the manufacture of synthetic rubber in primary forms to 37% for the manufacture of basic pharmaceutical products

Key: ● Joint carbon cost and trade intensity ● Trade intensity only reason ● Other criteria ● = approx. €20bn turnover

Source: Eurostat (average of 2003-2010), Delft (2013)

Note: Carbon costs were calculated assuming 75% auctioning of EUAs and an EUA price of €30 (Delft)

Survival of European polyethylene producers depend on a host of factors

EU producers use expensive feedstock

- The discovery of shale gas has caused a sharp decrease in gas prices. It is much cheaper to produce PE using light feed, rather than heavy feed
- In Europe, ethylene is produced in crackers that use heavy feed: European PE is more expensive to produce

EU producers cannot switch feedstock easily

- The way forward is to invest in gas terminals, switching feedstock from naphtha to gas
- However, given the age profile of European PE facilities, switching to light feed would require the rebuilding of plants in many cases

Threat from growing international competitors

- Increasing capacity additions in the Middle East have been threatening the European PE industry in the last few years, and will continue to do so
- New capacity in South East Asia, together with export substitution from the Middle East and even the US have substantially reduced the scope of European exports

EU producers are at a cost disadvantage

- International competitiveness is further eroded because of high labour costs
- Ineos had announced that it was closing its petrochemical plant at Grangemouth (Scotland), with a loss of 800 jobs. After protracted negotiations with the unions, a new agreement was signed and Ineos has committed to invest £300m to build a gas terminal for shale gas imported from the US

Carbon cost impact is important but not the decisive factor

- Carbon emissions from ethylene and PE production are much higher when heavy feeds are used instead of light feeds
- This means that even if other countries adopted similar policies to the ETS, European manufacturers would still be at a cost disadvantage, because they use heavy feed
- Converting PE pellets into moulds and sheets is very energy intensive. Higher energy prices therefore have a negative effect on PE producers
- European PE producers are at a strong cost disadvantage independently of carbon policies. Clearly, carbon policies will impact the industry – but its survival depends on a host of factors

The European polyethylene industry faces strong competitive pressures independently of carbon costs



Scaling up the impact to the whole economy

Removal of exemptions would impact the “carbon only” and the “joint criteria” groups but less so the “trade intensity” group

Carbon leakage sectors in policy discussions

- Policy discussions are dominated by a few sectors: steel, cement, chemicals, oil refining, aluminium and paper and pulp. These are not representative of the 164 sectors on the Carbon Leakage list
 - The sectors dominating the policy discussions belong to two groups on the carbon leakage list: carbon cost only and joint criteria. There are no sectors representing the 117 trade intensity sectors and the 18 ‘other’ sectors
- Albeit the second largest polluter, the cement sector is actually a very small sector in terms of turnover and employment
 - The cement sector employs around 60 thousand employees compared to the steel sector’s over 400 thousand. Turnover of the cement sector is €20 billion while that of the steel sector is €165 billion[†]
- Several recent studies have argued that the trade intensity criterion was set extremely conservatively and resulted in a highly inflated carbon leakage list
 - There is no detailed analysis of any of these sectors in the academic and consulting literature
 - Yet these sectors account for 64% of the turnover and 82% of the employment of the carbon leakage groups[†]

Impact of removing Carbon Leakage exemptions

- The impact of removing exemptions varies significantly across the 3 main carbon leakage groups:

Carbon only group

- The carbon only group’s EBITDA margin and employment is essentially unchanged at low carbon price levels (€5) but margins decline by 18% point and employment by 8% in the most severe scenario
- Total turnover and employment of this group is very small relative to the other groups’

Joint criteria group

- Despite the steel sector’s sensitivity to carbon costs, the group as a whole does not seem to be impacted by carbon costs
- This is driven by the fact that the steel sector alone emits as much carbon as the other 26 sectors in this group altogether

Trade intensity group

- Even at conservative estimates (i.e. the group is expected to not pass on any of the carbon costs to consumers), the impact on the trade intensity group’s margin is negligible. As costs are not expected to be passed through a significant volume or employment decline for these sectors is not expected

[†]Employee and turnover figures are averages for 2003-2010

We applied the cement and steel model results to the carbon and joint criteria groups, the trade intensity group was modelled differently

We model three types of effect:

- **Direct** - Sectors have to pay for carbon permits
- **Indirect** - Electricity producers have to pay for carbon, and they pass this cost onto CL sectors in the form of higher electricity prices
- **Volume** - CL sectors lose sales volumes, as they raise prices in an attempt to pass on some of the carbon cost

Approach differs by reason for inclusion in the CL list

Carbon cost group

Cement sector:

- Detailed bottom up model to estimate direct, indirect and volume effects

Other carbon cost sectors:

- Direct impact for each sector is estimated as 2013 allocations, times % auctioned, times assumed carbon price
- Indirect impact is estimated using data on electricity consumption, carbon intensity, electricity pass-through, and carbon price assumptions
- Carbon cost pass through (and impact on EBITDA and employment) is assumed in line with the estimated cost pass through of the cement sector

Joint criteria group

Steel sector:

- Detailed bottom up model to estimate direct, indirect and volume effects

Other joint criteria sectors:

- Direct and indirect impacts are estimates as per the method in the carbon cost group
- Carbon cost pass through (and impact on EBITDA and employment) is assumed in line with the estimated cost pass through of the steel sector

Trade intensity group

All trade intensity sectors:

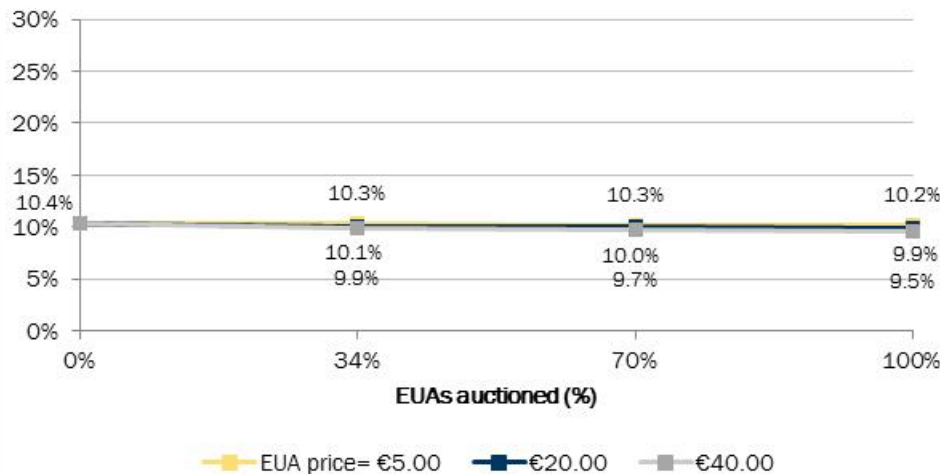
- Direct impact for each sector is estimated as 2013 allocations, times % auctioned, times assumed carbon price
- Indirect impact is estimated using data on electricity consumption, carbon intensity, electricity pass-through, and carbon price assumptions
- Zero cost pass through is assumed given the constraints resulting from high trade intensity. The sectors are expected to pay for their permits from their margins

Key assumptions: cement and steel sectors are good proxies for the electricity intensity and pass through behaviour of their respective groups

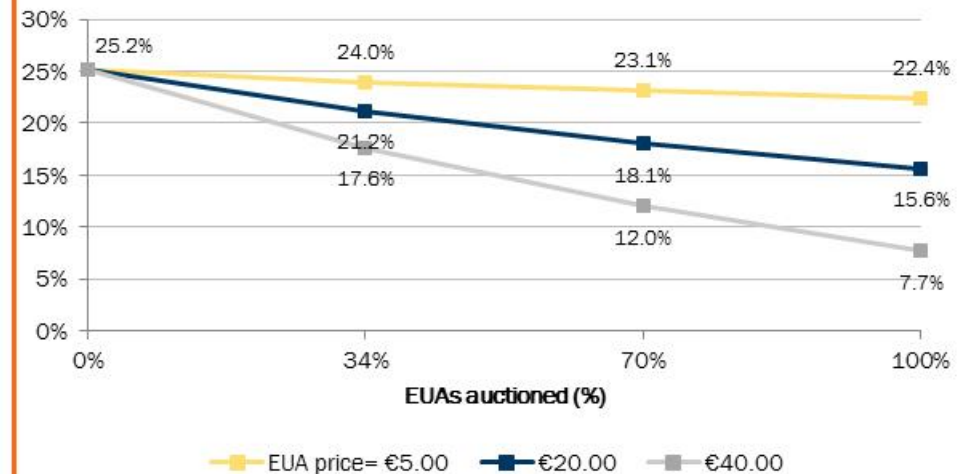
Key assumption: sectors absorb carbon costs

Only the carbon cost group experiences significant declines in EBITDA margin- the impact on the carbon leakage groups' overall EBITDA margin is modest

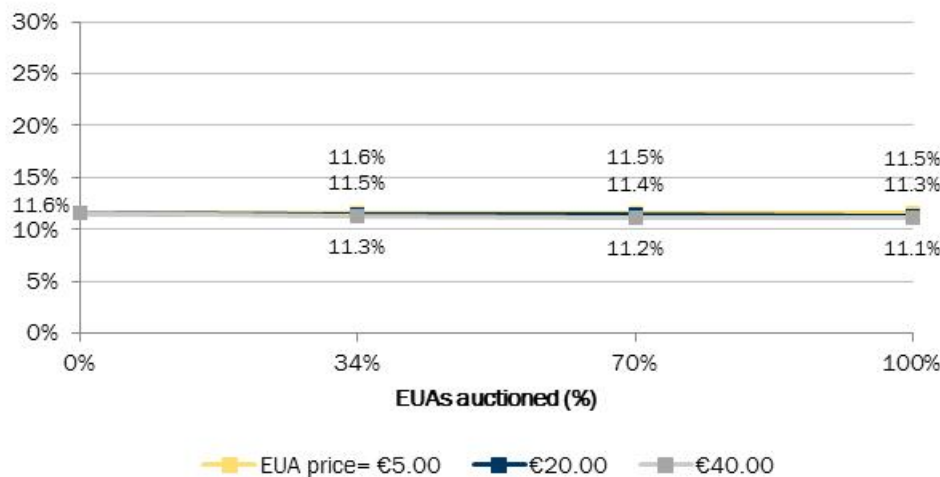
Major Carbon Leakage groups' EBITDA margins



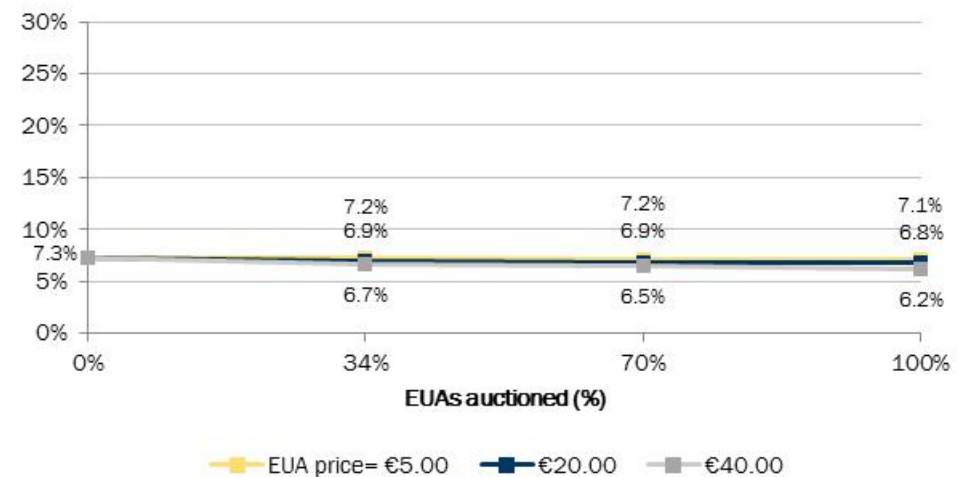
Carbon cost group's EBITDA margin



Trade intensity group's EBITDA margin



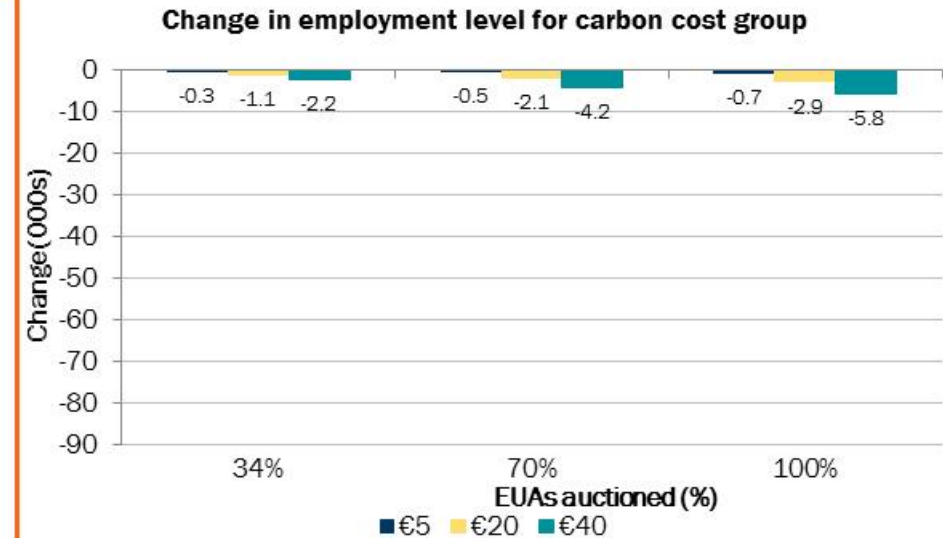
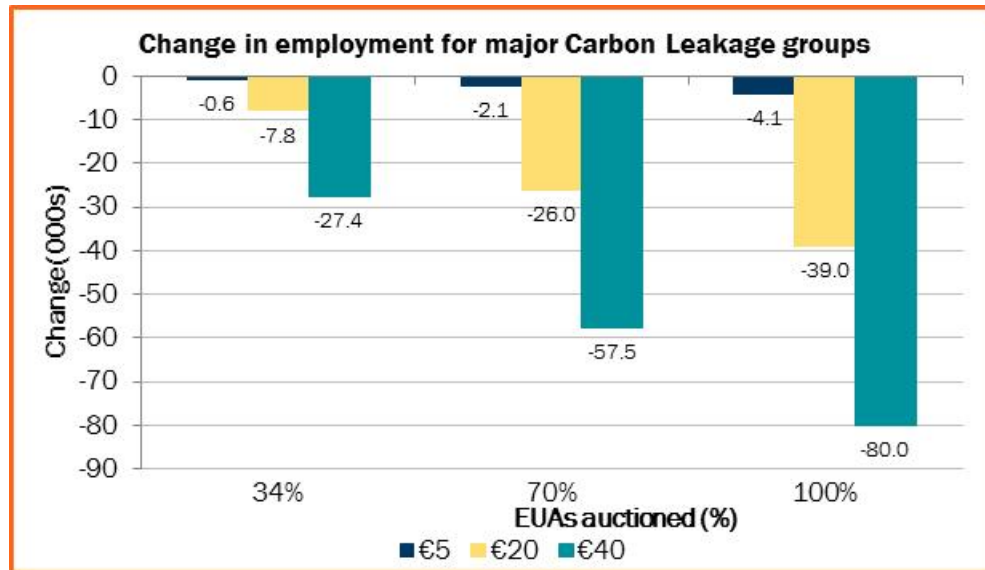
Joint group's EBITDA margin



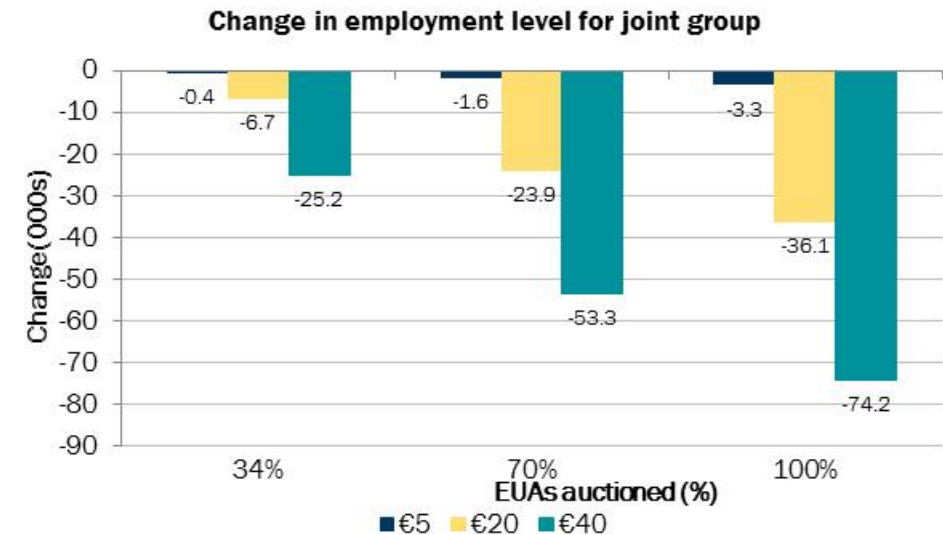
Source: FTI Consulting analysis

Note: Only the carbon cost, joint and trade intensity groups of the Carbon Leakage list are included in the analysis.

The CL sectors' employment is expected to fall by 80 thousand employees in the most severe scenario



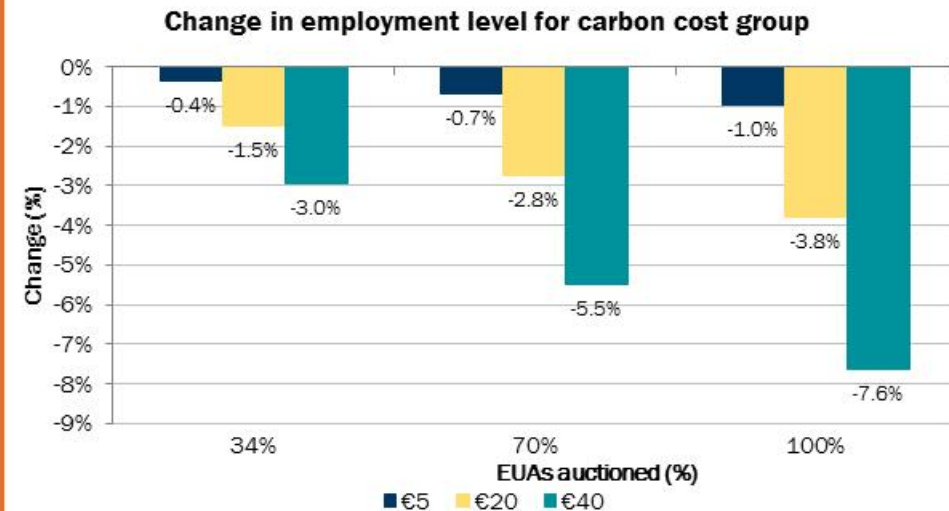
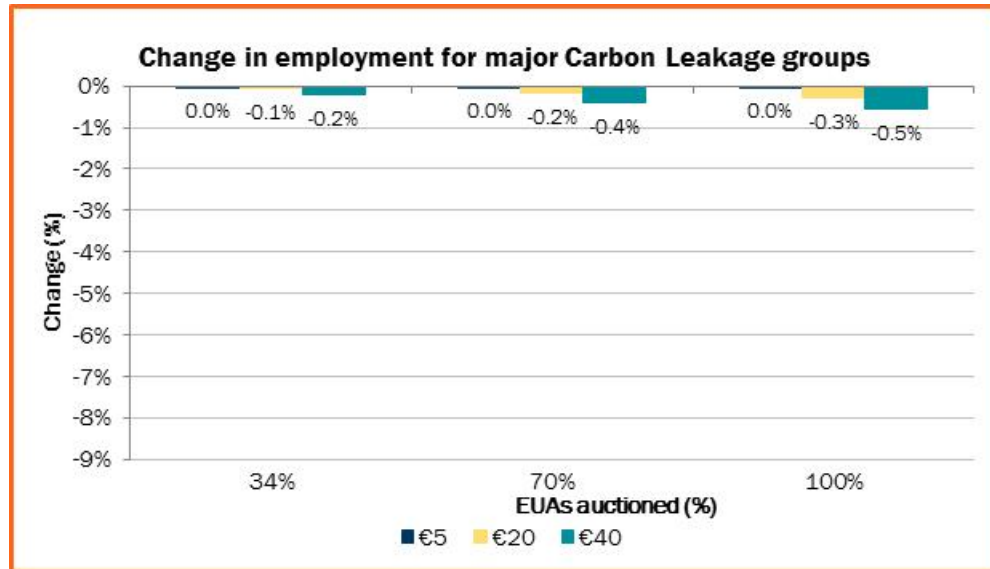
Trade intensity sectors are assumed to absorb the costs by in EBITDA. There is no estimated employment impact.



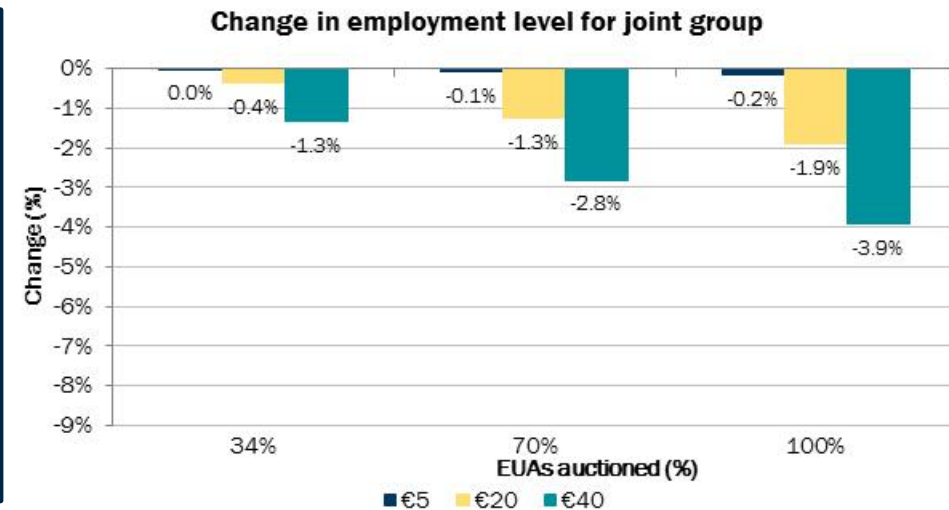
Source: FTI Consulting analysis

Note: Only the carbon cost, joint and trade intensity groups of the Carbon Leakage list are included in the analysis.

Employment decline is negligible for the CL groups as a whole but is up to 8% for the carbon cost group



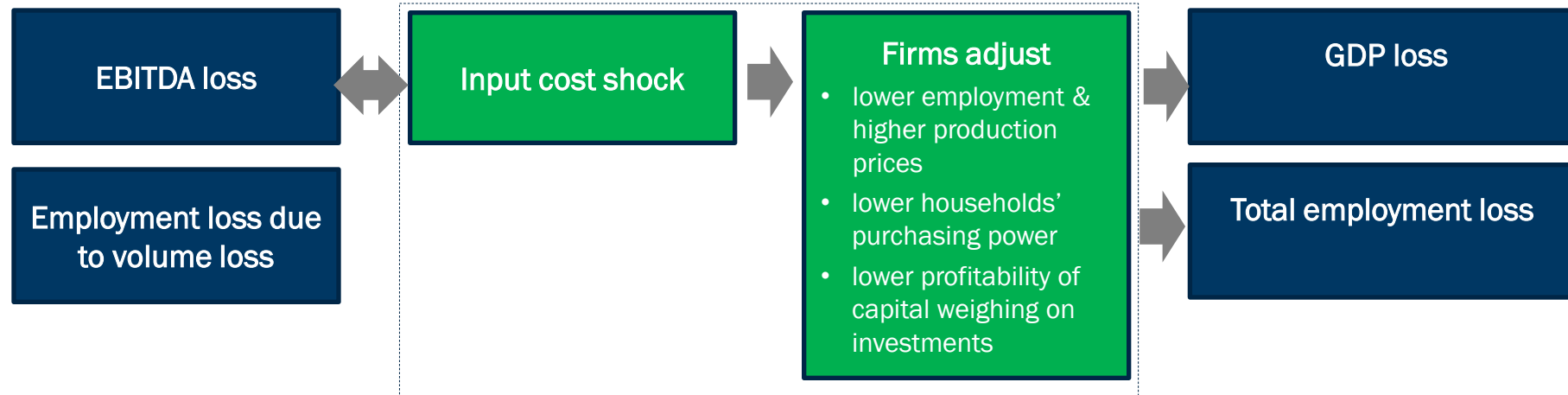
Trade intensity sectors are assumed to absorb the costs by in EBITDA. There is no estimated employment impact.



Source: FTI Consulting analysis

Note: Only the carbon cost, joint and trade intensity groups of the Carbon Leakage list are included in the analysis.

Dynamic impact of direct EBITDA and employment loss



Methodology and calculations

GDP loss

- Typical impact of cost shock on GDP: 1ppt increase in labour social contributions decreases GDP by 0.3ppt
- This is a relatively optimistic order of magnitude since the profitability of capital is also lessened when the carbon price increases.
- We considered two scenarios: 1.) The lower case assumes that only the cost of labour is modified. 2.) The upper case assumes that both the labour cost and the remuneration of capital are modified.
- Then we calculated a 0.3-0.4% increase in costs and a corresponding upper case of -0,02% GDP loss and a lower case of -0,01% GDP loss
- We used EU GDP (of 12,899 billion) to calculate the total GDP loss.

Employment loss

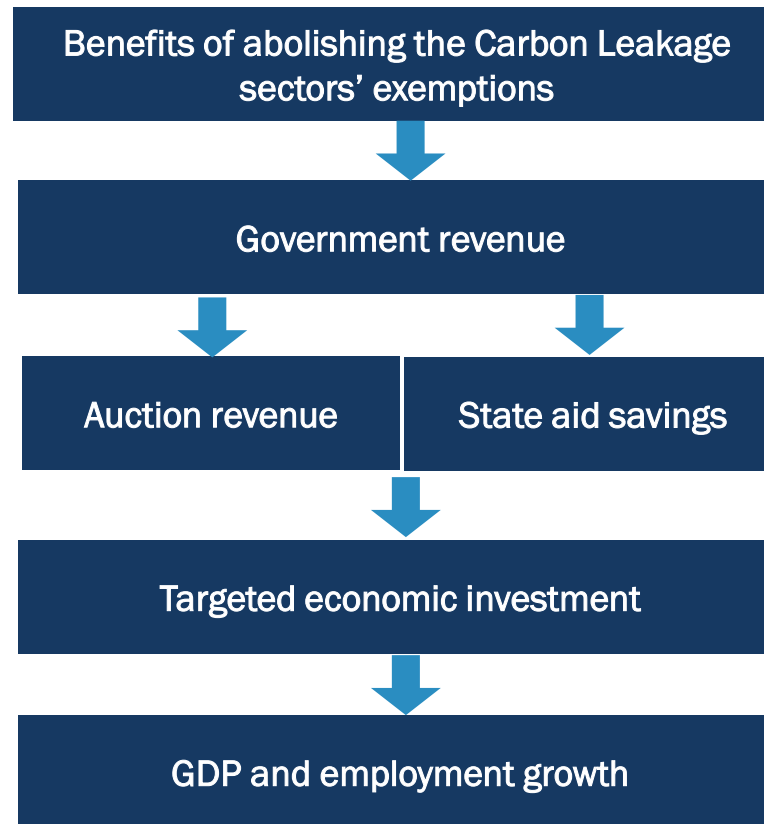
- An increase in labour costs impacts employment through the elasticity of labour supply to the cost of labour.
- We use standard macroeconomic simulations of a rise in the cost of labour and its impact on employment in France.
- We apply a limited correction to the result obtained so that the average wage of labour flowing from these estimates corresponds to the average EU remuneration of labour.

GDP loss ranges from €2bn to €24bn and employment from 16K to 255K in the different scenarios

Scenario	EBITDA loss	GDP loss	Commentary
Carbon price: €5/t Auctioning: 34%	€ 2,2bn	€1,5bn - €2,0bn	<ul style="list-style-type: none"> If carbon leakage exemptions are removed the economy is expected to lose between €1,5bn - €23,6bn (0.01-0.2% of EU GDP) depending on the scenario.
Carbon price: €20/t Auctioning: 70%	€ 10,6bn	€7,0bn - €9,5bn	
Carbon price: €40/t Auctioning: 100%	€ 26,3bn	€17,5bn - €23,6bn	
Scenario	Direct employment loss	Total employment loss	Commentary
Carbon price: €5/t Auctioning: 34%	600	16,000 - 22,000	<ul style="list-style-type: none"> If carbon leakage exemptions are removed the economy is expected to lose between 16,000 - 255,000 employees (0.1-1.7% of Carbon Leakage sectors' employment and 0.01-0.1% of EU employment) depending on the scenario.
Carbon price: €20/t Auctioning: 70%	26,000	76,000 - 103,000	
Carbon price: €40/t Auctioning: 100%	80,000	189,000 - 255,000	

The benefits of removing exemptions for carbon leakage sectors

The main source of benefits from removing carbon leakage exemptions is government revenues that can be recycled into the economy



We estimate the potential economic benefits of removing exemptions of the carbon leakage sectors in three steps

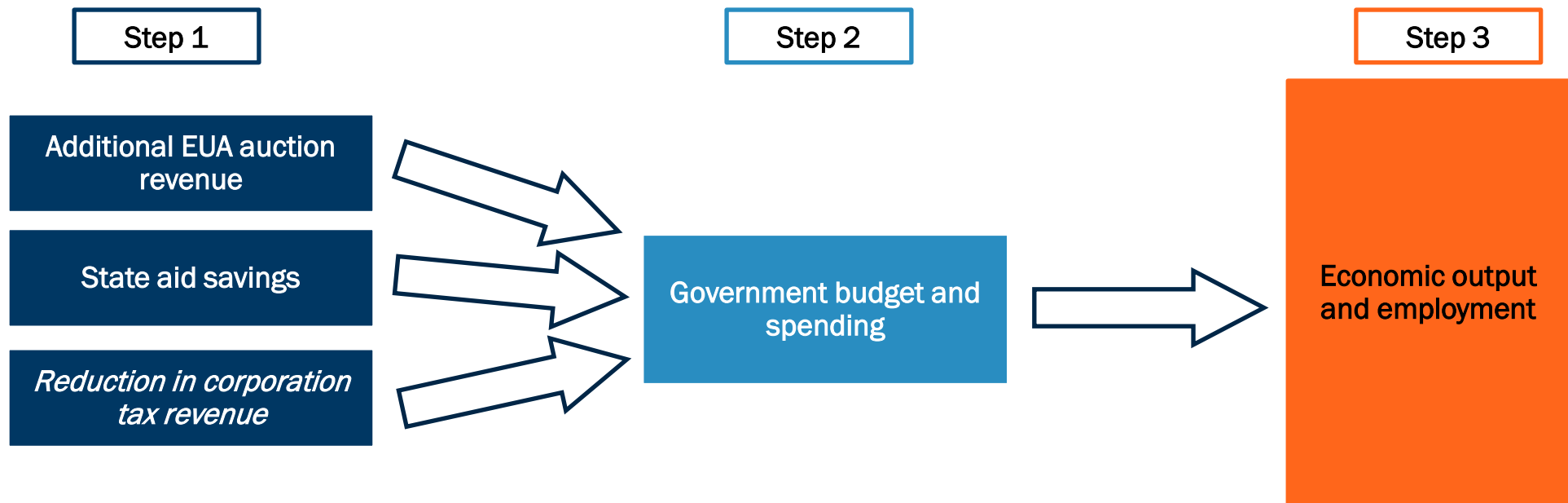
Approach:

■ Step 1: Model three benefit channels:

- Additional EUA auction revenues
- State aid savings
- *(Offset by a reduction in corporation tax revenue due to the carbon leakage sectors' fall in profits)*

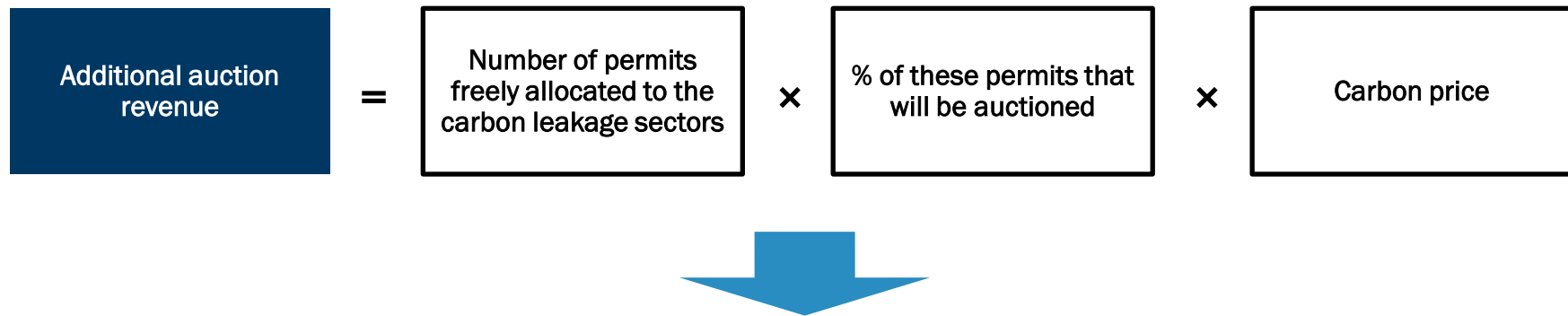
■ Step 2: For each of these channels, model the effect on government final demand

■ Step 3: Estimate the overall effect including multiplicative impact on economic output and employment using IO tables



If carbon leakage exemptions are abolished governments will receive revenue from auctioning permits...

Calculation of additional auction revenue if carbon leakage exemptions are removed:



Estimates of additional auction revenue range from €1 billion - €30 billion:

Estimates of EUA auction revenue (€ billion)			
EUA price (€/tonne)	Auctioning percentage		
	34%	70%	100%
5	1.3	2.6	3.7
20	5.0	10.3	14.7
40	10.0	20.6	29.5

Source: FTI Consulting analysis

... and will save state aids offered as a compensation for indirect costs

Estimates of the magnitude of the state aid differ between Member States

- The German government has set aside **€350 million** for 2013 (Source: BUND, 2013), and the aid intensity is expected to be approximately **70%** (Oeko Institute for Applied Ecology, 2013)
- The UK government has allocated up to £113 million over the Spending Review Period (approximately £50m or **€59m annually**), and the aid intensity is intended to be the maximum permissible **85%** (Source: BIS, 2013)
- The Netherlands government intends to provide €624m over eight years (approximately **€78m annually**), although the expected aid intensity has not been published

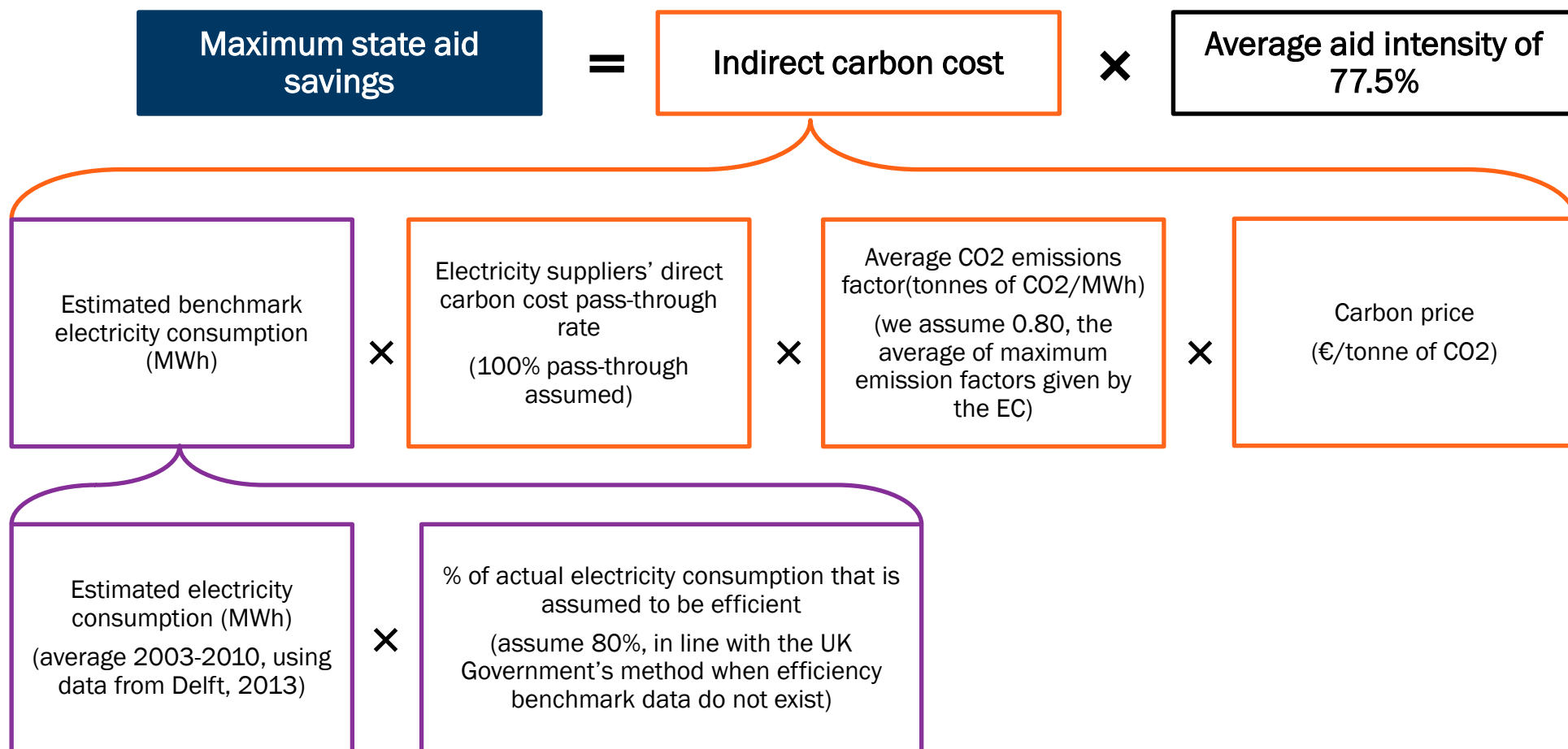
Our modelling approach

- Other Member States may also intend to provide such aid, but details have not been published
- We therefore estimate state aid savings in two scenarios:

State aid saving scenario	Description	Details
1	ONLY Germany, UK and Netherlands provide state aid	The total state aid is therefore €487m (sum of €350m for Germany, €59 for UK, and €78m for the Netherlands) For modelling purposes, we assume this amount is spend throughout the EU (not just in UK, Germany, and the Netherlands)
2	All Member States provide state aid	We assume the average EU wide aid intensity is 77.5% (i.e. the average of the UK and Germany)

We estimate state aid savings in two scenarios

- In Scenario 1, we assume the annual state aid savings are **€487m** according to published estimates of Germany, the UK and the Netherlands
- In Scenario 2, we estimate the annual state aid savings using a formula similar to that published by the EC (our method differs slightly due to data availability).
- Our method and assumptions are set out below:



We also estimate the fall in corporate tax revenue as a result of the carbon leakage sectors' loss of EBITDA

- We estimate the fall in corporate tax revenue as:

$$\text{Fall in corporate tax revenue} = \text{Fall in taxable income} \times \text{Corporate tax rate}$$

Fall in taxable income

- We estimate the fall in taxable income using the fall in EBITDA modelled for the carbon leakage sectors
- We recognise that EBITDA is not the same as taxable income – so this is a simplifying assumption
- For example, although tax rules differ between Member States, adjustments are made to EBITDA to calculate taxable income (for example, a depreciation expense may be deducted)
- The fall in EBITDA varies from €2.2bn (when the carbon price is €5 and 34% of permits are auctioned), to €42.4bn (when the carbon price is €40 and 100% of permits are auctioned)

Corporate tax rate

- We use a representative corporate tax rate of 27.8%
- Since our modelling is at the EU level (and not country by country), we use a single tax rate
- Corporate tax rates vary within the EU, from 10% (in Bulgaria and Cyprus) to 35% (in Malta)
- We calculate a weighted average corporate tax rate of 27.8%, using the Member States' GDP in 2012 (at market prices) as a weight

We model this as a reduction in government spending across the economy, in proportion to the government's existing pattern of spending

We model the impact of government spending on economic output and employment

Impact on economic output

- The effect of increased spending propagates throughout the economy, fading in intensity at each stage of the supply-chain. The overall effect on economic output is a multiple of the initial effect
- For each sector in the economy, we estimate the overall effect in economic output, using “Type I” multipliers derived from the IO tables*

$$\text{Increase in economic output} = \text{Initial increase in final demand} \times \text{IO multiplier}$$

Impact on employment

- An increase in economic output is associated with an increase in the labour required to produce it
- For each sector, we first estimate the amount of labour required to produce €1m of economic output, i.e. the labour intensity of output
- We then estimate the increase in employment as below:

$$\text{Increase in employment} = \text{Increase in economic output} \times \text{Labour intensity of output}$$

*Note that these Type I multipliers capture the supply chain, or production linkages in the economy. It is also possible to consider “Type II” or consumption multipliers, that consider the additional effect on economic output induced by an increase in wages

We model three scenarios for the recycling of government revenues into the economy

Scenarios:

1. The additional revenue is spent in line with the existing pattern of government spending

- Member States' governments spend the majority of their budgets on public administration, defence, education, health and social work
- In this scenario, we assume that the additional revenue is distributed similarly to other general tax revenues

2. The additional revenue is earmarked for research and development and clean technologies

- In this scenario, we assume that the funds are designated according to the EC's six "Priority Action Lines" for investment, based on an example of the sectors in which this investment could take place

3. The additional revenue is earmarked for the manufacturing sector

- In this scenario, we assume that the funds are distributed back to the manufacturing industry

Product category	Allocation of additional government spending		
	Existing pattern of spending	R&D, clean technologies	Manufacturing
Products of agriculture, forestry and fishing	0%	0%	0%
Mining and quarrying	0%	0%	0%
Manufactured products	2%	40%	100%
Electricity, gas, steam and air conditioning	0%	0%	0%
Water supply; sewerage, waste management and remediation services	0%	0%	0%
Constructions and construction works	0%	20%	0%
Wholesale and retail trade services; repair services of motor vehicles and motorcycles	2%	0%	0%
Accommodation and food services	0%	0%	0%
Transportation and storage services	1%	0%	0%
Information and communication services	0%	0%	0%
Financial and insurance services	0%	0%	0%
Real estate services	1%	0%	0%
Professional, scientific and technical services	2%	40%	0%
Administrative and support services	0%	0%	0%
Public administration and defence services; compulsory social security services	38%	0%	0%
Education services	20%	0%	0%
Human health and social work services	31%	0%	0%
Arts, entertainment and recreation services	2%	0%	0%
Other services	0%	0%	0%
Services of households as employers; undifferentiated goods and services produced by households for own use	0%	0%	0%
Services provided by extraterritorial organisations and bodies	0%	0%	0%
Total	100%	100%	100%

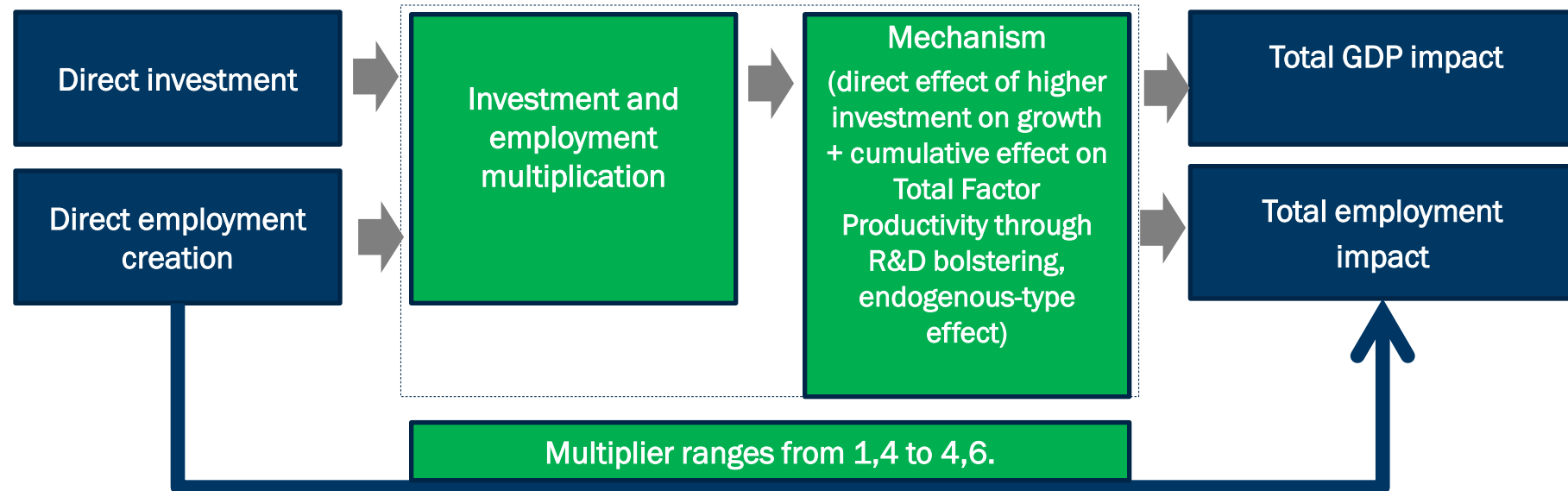
Source: Eurostat Input-Output tables (2009), FTI Consulting analysis

The effect of recycling additional government revenue on economic output depends on how it is spent

- The table below illustrates the estimated effect on economic output and employment in the three different spending scenarios
- These impacts are conservative, because they include an indirect multiplier effect (of additional demand created throughout the supply chain, or Type I multipliers), but not an induced consumption effect (of higher household wages inducing further increases in spending, or Type II multiplier). Induced consumption effects may magnify the increase in economic output, by between 20% and 58%. (Estimates vary widely; for example, Type II multipliers are 20% higher than Type I multipliers in Scotland, 58% higher in the Australian economy, or 29% higher in Oregon, USA)
- If the additional government budget is:
 - Spent in line with existing government spending, this leads to an increase in economic output of between €2.2 billion and €42.9 billion (or 0.02% to 0.36% of EU GDP in 2009), and employment of between 35,500 and 702,000 additional employees (0.02% to 0.31% of EU employment in 2009)
 - Earmarked for R&D and clean technologies, economic output increases by up to €60.6 billion, and employment by up to 653,800
 - Earmarked for the manufacturing sector, economic output increases by up to €66.8 billion, and employment by up to 861,200
- The latter two spending plans deliver greater economic benefits because they target spending in areas of the economy with greater output and employment multipliers

Scenario (Carbon price, % auctioned)	Net change in government spending (€ billions)	Impact on economic output (€ billions)	Impact on employment (thousands of employees)	Impact on economic output (€ billions)	Impact on employment (thousands of employees)	Impact on economic output (€ billions)	Impact on employment (thousands of employees)
		Spent in line with existing government spending		Earmarked for R&D and clean technologies		Earmarked for the manufacturing sector	
€5, 34%	1.5	2.2	35.5	3.2	32.7	3.5	44.7
€5, 70%	2.5	3.7	60.8	5.4	56.2	6.0	75.8
€5, 100%	3.4	5.0	82.5	7.2	76.3	8.0	102.4
€20, 34%	6.1	9.0	148.2	13.1	136.9	14.6	184.9
€20, 70%	10.7	15.9	260.3	22.6	241.7	24.9	320.4
€20, 100%	14.4	21.4	350.2	30.2	325.6	33.4	429.9
€40, 34%	12.7	18.9	310.2	27.1	287.5	30.0	383.6
€40, 70%	21.6	32.1	525.4	45.4	488.3	50.2	645.6
€40, 100%	28.8	42.9	702.0	60.6	652.8	66.8	861.2

Multiplicative effect of targeted investments



Methodology and calculations

Relevant multipliers in the literature

- Public investment for high technologies with dual impact (military and civilian). Ramey (2008) suggests here a multiplier of 1,5 (using a VAR model). A monography of Oxford Economics on BAE suggests a multiplier between 1,4 and 1,7.
- Tax expenditures in favour of R&D can also entail sizeable dynamic, leverage effects. Mulkay and Mairesse (2004) find that 1€ of tax expenditures fostering R&D increase total R&D by 3€ to 4,6€, including 2€ to 3,6€ from the private sector.
- The QUEST III model used by the European Commission (Arpaia, Roeger et al., 2007) suggests that a rise in R&D spending of 1,1% of GDP would trigger an upward effect on GDP of slightly less than 2,6%.

Total GDP and employment impact calculation

- Assuming that the elasticity of employment to GDP is 1 in the long-run – which has strong theoretical justifications, we directly derive the effect on employment using the average cost of labour in the EU27.

The impact of removing carbon leakage exemptions on economic output ranges from €3bn in an ineffective ETS scenario to €61bn in an effective ETS scenario

(€ billions)	Ineffective ETS with high compensation	Moderate ETS with medium compensation	Effective ETS with no compensation
Carbon price	€5	€20	€40
% auctioning	34%	70%	100%
Initial change in EU wide final demand			
(1) Additional EUA auction revenues†	€1.3bn	€10.3bn	€29.5
(2) State aid savings†	€0.8bn	€3.3bn	€6.6bn
(3) Reduction in corporation tax†	- €0.6bn	- €2.9bn	- €7.3bn
Total (1 + 2 + 3)	€1.5bn	€10.7bn	€28.8bn
Multiplicative change in economic output and employment			
Additional EU GDP	€3bn <i>(0.02% of EU GDP)</i>	€23bn <i>(0.2% of EU GDP)</i>	€61bn <i>(0.5% of EU GDP)</i>
Additional employment††	33,000 – 34,000 <i>(~0.01% of EU employment)</i>	242,000 – 310,000 <i>(~0.1% of EU employment)</i>	653,000 – 790,000 <i>(~0.4% of EU employment)</i>

Source: FTI Consulting analysis

Note: †Through the use of IO tables, government spending is earmarked to R&D and clean technology. All member states are assumed to provide state aid.

†† Employment impact was estimated using two methods: assuming a constant ratio of GDP/employment and back calculating the increase in labour remuneration as a result of increased GDP and the number of employees corresponding to the given remuneration.

Conclusions: Net effects of removing exemptions for carbon leakage sectors on GDP and employment

Our findings suggest that benefits will likely outweigh the costs of abolishing the carbon leakage sectors' exemptions

Costs of carbon leakage		Benefits of abolishing CL exemptions		Commentary
Ineffective ETS, high compensation		Ineffective ETS, high compensation		Ineffective ETS, high compensation
GDP loss	€1.5 - 2.0 billion	GDP gain	€3.2 billion	<ul style="list-style-type: none"> ▪ The economy gains €3.2 billion in GDP (0.02% of the EU's total GDP) compared to the carbon leakage sectors' €1,5-2,0 billion GDP loss ▪ The net employment generation is between 11,000 -18,000 employees (~0.01% of the EU's total employment)
Employment loss	16,000- 22,000 employees	Employment gain	33,000 – 34,000 employees	
Moderately effective ETS, medium comp.		Moderately effective ETS, med comp.		Moderately effective ETS, med comp.
GDP loss	€7.0 - 9.5 billion	GDP gain	€22.6 billion	<ul style="list-style-type: none"> ▪ The economy gains €23billion in GDP (0.2% of the EU's total GDP) compared to the carbon leakage sectors' €7.0-9.5 billion GDP loss ▪ The net employment generation is between 137,000 – 234,000 employees (~0.1% of the EU's total employment)
Employment loss	76,000 – 103,000 employees	Employment gain	242,000 – 310,000 employees	
Effective ETS, no compensation		Effective ETS, no compensation		Effective ETS, no compensation
GDP loss	€17.5 – 23.6 billion	GDP gain	€60.6 billion	<ul style="list-style-type: none"> ▪ The economy gains €61 billion in GDP (0.5% of the EU's total GDP) compared to the carbon leakage sectors' €17,5-23,6 billion GDP loss ▪ The net employment generation is 398,000 – 601,000 employees (~0.3% of the EU's total employment)
Employment loss	189,000 – 255,000 employees	Employment gain	653,000 – 790,000 employees	

Source: FTI Consulting analysis

Note: Ineffective ETS assumes 34% auctioning and €5 EUA, Moderately effective ETS assumes 70% auctioning and €20 EUA and Effective ETS assumes 100% auctioning and €40 EUA. Government spending assumed to be earmarked for R&D and cleantech. All countries assumed to provide state aid at 77.5% intensity

It is important to note that the impact of removing exemptions for these sectors would be gradual for many reasons

Sectors have banked significant amount of allowances

Increase in carbon prices will be gradual

Increase in auctioning percentages will be gradual

Several sectors will benefit from decarbonisation

Global framework on decarbonisation is progressing

ETS revenues will be used to help transition to low-carbon technologies

Jos Delbeke, DG for Climate Action at European Steel Day, May 2013:

*“Different ex-post studies show that, with the protection offered by free allocation and international credits, the ETS-related costs for energy intensive industries have been at most 2%, and in many cases even less. In addition, the steel industry has **benefited from a considerable free allocation**...*

*... I should underline that the **transition to a low carbon economy will create lots of business opportunities** for sectors such as steel, cement and chemicals given the investments that will be required in buildings, transport infrastructure and other areas....*

*... **Australia, Korea, China, but also South Africa, Brazil, Mexico and others are either setting up their own emission trading schemes** – some of which will be linked to the EU ETS - or implementing very tough national measures. South Africa is one of the latest players to get on board with work to introduce a carbon tax. These economies are no longer climate 'free riders', as is sometimes claimed....*

*... we are preparing the ground for **using part of the ETS related revenues to support energy intensive industries** in the quest to develop innovative low-carbon technologies...”*

About FTI Consulting

FTI Consulting Compass Lexecon is an established advisory firm with an existing presence in the energy sector

Heritage & structure

- Established in 1982
- c. 4,000 staff across 24 countries
- Five divisions:
 1. Economic & Financial Consulting
 2. Corporate Finance
 3. Forensic & Litigation Support
 4. Strategic Communications
 5. Technology
- We're about deploying senior experts to help clients navigate critical decisions

Energy capability

1. Competition, disputes
2. Regulation, policy
3. Strategy
4. Market modelling

Example offerings

- Economic support to large commercial disputes
- Policy, regulation and incentive design
- Scenario planning & corporate strategy formulation
- Business case development & investment decisions support
- Energy market modelling
- Renewables investment & international supply chain

Experience

- **European Utilities:** range of strategy assignments, involving power, gas, and carbon market modelling
- **Financial players:** technical and commercial due diligence for both regulated and merchant assets
- **European utilities:** range of gas market & renewables disputes
- **Regulators and network operators:** studies on incentive regulation, costs of capital, etc.

Key contacts



Dr Fabien Roques

Senior Vice President

CompassLexecon

Contact information

froques@compasslexecon.com

Direct: +33 153053629

Mobile: +33 788371501



Dr Meloria Meschi

Managing Director

FTI Consulting

Contact information

meloria.meschi@fticonsulting.com

Direct: +44 20 7632 5119

Mobile: +44 75 4530 1465



Dr Dora Grunwald

Director

FTI Consulting

Contact information

dora.grunwald@fticonsulting.com

Direct: +44 20 7632 5127

Mobile: +44 7912 561 093

Appendices

Steel industry questionnaire and interviews

We have conducted interviews with experts in the steel industry

#	Steel expert background
1	Former Director of Raw Materials at ArcelorMittal
2	Former Director of Steel Research at Metal Bulletin
3	Former General Director of Technology at Italsider/Ilva
4	Former General Manager of Wheeling-Pittsburgh
5	Former Director of Strategy at ArcelorMittal
6	Former Sales Director at Duferco
7	Former Head of Stainless Steel Division at Stencor

- The consultation with these experts generally lasted two hours. The advisors first filled out the questionnaire and this was followed by an hour long phone conversation
- The experts' diverse backgrounds enabled us to cover specific topics, for example related to different technologies, particular product segments, different distribution channels, differences across geographies
- Naturally, their opinions differed especially regarding the questions of cost pass through and import substitution. We have used the average cost pass through and demand elasticity estimate for our model and discussed the range of estimates that the experts provided

Questionnaire

Memorandum

RE: **Steel expert questionnaire – international competitiveness of the EU steel sector, and carbon leakage**

Introduction

We are analysing the competitiveness of the EU steel sector, in particular we are focusing on the impact of carbon costs on European producers' competitiveness vis-à-vis non-EU producers. We would very much appreciate your help in understanding a few key issues. **Please note that we are not asking for any company specific confidential information. Our questions relate to the EU steel industry in general.** Additionally, we are also talking to other experts and we will present our results at an aggregated level, i.e. we will treat your responses confidential.

Our aim is to model the impact of carbon cost increases on prices, sales and profitability of EU producers while assuming that the non-EU competitors do not face carbon costs. We would like to improve our understanding in the following areas:

- Long term profit margins of EU producers vs. key non-EU competitors',
- Import substitution
- Transportation costs
- Pricing
- Cost pass-through
- Abatement
- Plant location choices

1. Long term profit margins

We are considering two production technologies: a blast oxygen furnace (BOF) and electric arc furnace (EAF)

We will assume that BOFs produce flat products (here modelled: hot rolled coil, HRC) and EAFs produce long products (here: wire rod, WR).

The tables below show the financial performance for representative EU BOFs and EAFs in 2012.¹ In fact, 2012 was a relatively weak year for the industry in terms of production volume, which is very sensitive to the economic cycle.

Simplified income statement (€/tonne)

	BOF - HRC	EAF - WR
Price	515	523
Total cost	485	485
Raw materials	340	320
Gross profit	175	203
Gross margin	34%	39%
Energy	5	80
Other cost	120	85
EBITDA	50	58
EBITDA margin %	10%	11%
D&A	41	15
EBIT	9	43
EBIT margin %	2%	8%
Interest and tax	12	5
Net profit	-3	38
Net margin %	-1%	7%

Composition of 'total costs'

	BOF - HRC	EAF - WR
Raw materials	73%	88%
Energy	1%	13%
Other	26%	18%

¹ ASSESSMENT OF CUMULATIVE COST IMPACT FOR THE STEEL INDUSTRY – Centre for European Policy Studies, June 2013. The report analysed and aggregated data available in the World Steel Dynamics database for Western- and Eastern-European plants.

Questionnaire

Total cost	100%	100%
------------	------	------

1.1 What would you expect the steel price, raw material cost, and margins to be at:

- The trough of the cycle?
- The peak of the cycle?
- On average during the cycle

Please fill out the table below, and leave cells blank that you don't feel comfortable answering.

Key financials at different stages of the economic cycle (€/tonne)

Technology	BOF - HRC				EAF - WR			
Stage of economic cycle	2012	Trough	Average	Peak	2012	Trough	Average	Peak
Price	515				523			
Raw material cost	340				320			
Gross margin %	34%				38%			
EBITDA margin %	10%				11%			
EBIT margin %	2%				8%			
Net margin %	-1%				7%			

2. Import substitution

Our understanding of finished steel imports is that:

- EU finished steel imports have been volatile: from 18 million tonnes in 2004 to 32 million tonnes in 2007 and back to 12 million tonnes in 2009
- This is about 8-18% of EU production (from 200 million tonnes to 170 million tonnes production during 2004-2012)
- Import reacted to the boom and recession: import has risen much faster than production in the boom years and fell much faster than production in the recession

2.1 Do you think this indicates that imports are only competitive when the EU is near production capacity?

Nearly 80% of EU imports are in higher value flat products (in 2012) and the share of these flat products has been increasing steadily since 2004

2.2 Why do you think the share of flat products is increasing?

We are interested in the drivers of competition between EU produced steel, and steel imported from outside of the EU. In deciding between these two sources of steel, purchasers may take into account a number of factors/criteria, including differences in price, quality, proximity, or customer service.

2.3 How important do you think each of these criteria are, to this decision of which source to use? Please indicate the importance of each criterion, using the following scale (5 very important – 1 not important) Are there any additional criteria that should be included? If so, please add them to the table, and indicate their importance in a similar way.

Importance of drivers of competition

Driver of competition	Flat products	Long products
Price		
Quality		
Proximity to buyer		
Service		

2.4 In relation to these drivers/criteria, how well does EU produced steel fare relative to steel imported from outside the EU? Please discuss by long/flat product and by naming competing countries, if possible

Questionnaire

	Flat products	Long products
Price		
Quality		
Proximity to buyer		
Service		
[Other drivers?]		

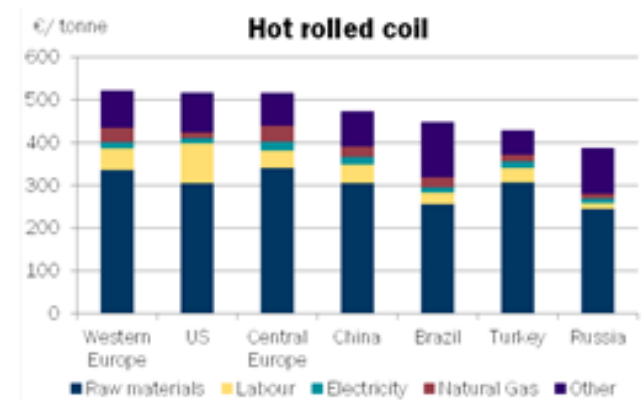
2.5 Are there any limits to the availability of import products? For example, are there:

- Export quotas in competitor countries
- Bottlenecks in production capacities of nearest competitors
- Significant transportation costs
- Port capacity constraints
- Other?

3. Transportation costs

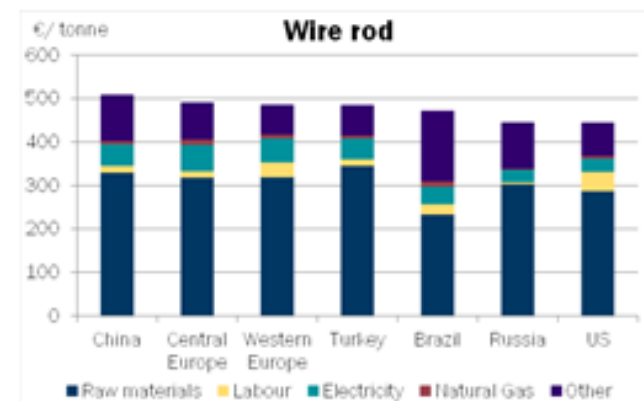
The charts below show that steel production costs within the EU are generally higher than outside the EU.

BDF HRC steel production costs (€/tonne)



Source: Assessment of Cumulative Cost Impact for the Steel Industry, Center for European Policy Studies (based on World Steel Dynamics data)

EAF WR steel production costs (€/tonne)



Source: Assessment of Cumulative Cost Impact for the Steel Industry, Center for European Policy Studies (based on World Steel Dynamics data)

Questionnaire

However, the additional cost of transporting steel from a non-EU country producer, to a consumer within the EU, may weaken the competition between EU and non-EU producers.

- 3.1 Please describe the most important factors that determine transportation costs. How does the transportation cost depend on the route, the mode of transport, the distance, the nature of the steel, the size of the order?

- 3.2 On average, what is the cost of transporting steel from a non-EU producer, to a consumer within the EU? Please give your answer in terms of \$/tonne of steel/mile transported

4. Pricing

- 4.1 To what extent do steel producers and consumers enter into long term, steel supply contracts? Is it different for flat vs. long products?

- 4.2 What is the nature of these contracts? Do producers and consumers agree fixed steel volumes, and a pricing formula (perhaps linked to inflation, or to the spot market price of steel)?



5. Cost pass through

'Cost pass through' refers to the ability of a firm to pass on an increase in its costs, to its customers by raising the price. For example, if a firm's total costs increase by 5%, it may:

- Keep its price unchanged (absorbing the cost increase, or equivalently, passing on 0%); or
- Increase its price (passing on up to the full 5% cost increase)

- 5.1 If all EU steel producers' costs increase by X%, while non-EU steel producers' costs remain unchanged, how much would EU steel producers be able to pass through? Please assume an 'average' year for the industry (i.e. not trough or peak). Please indicate a % pass through for a cost increase of 5%, 10%, 15%, 20%, and 25%.

Cost pass through rates

X% cost increase	5%	10%	15%	20%	25%
Cost pass through for Hot rolled coil					
Cost pass through for Wire rod					

- 5.2 If all EU producers were to raise their prices by X%, and their non-EU competitors' prices were unchanged, how much would the demand for the EU producers' steel change? Please indicate in the table below.

Change in EU sales volumes, for an X% increase in EU price

Increase in EU price	5%	10%	15%	20%	25%
Change in EU sales volume for Hot rolled coil					
Change in EU sales volume for Wire rod					

6. CO2 emissions abatement

We understand that EAF plants have fewer direct CO2 emissions than BOF plants. However, EAF plants use scrap steel as an input, and so we understand that there is likely to be an upper limit to proportion of steel production from EAF plants.

- 6.1 To what extent are EAF plants able to substitute for BOF plants?

Questionnaire

We understand that steel producers may have other options available to reduce their carbon emissions. These options may relate to:

- Modifying the mix of inputs used in the production process (e.g. coke substitution)
- Modifying the production process itself (e.g. the use of electrolysis, onsite co-generation of heat and electricity, continuous casting, smelt reduction)
- Improving energy efficiency
- 'Retrofit' technologies, e.g. 'end-of-pipe' devices
- Replacing existing steelmaking technologies with newer, lower carbon intensity alternatives
- Carbon capture and storage (CCS)

8.2 Can you please discuss the options available to the industry to reduce its carbon emissions? Please distinguish between BOPs and EAPs, if possible. We are particularly interested in:

- The carbon intensity of these options (in tonnes of CO₂/tonne of steel)
- Whether these options are well established or experimental
- Your view on which options are most feasible/practicable

8.3 As the price of carbon increases, we would expect a greater number of these abatement options to become economic/cost-effective. For each of the abatement options identified above, can you please indicate:

- The price of carbon at which they would become cost-effective,
- The volume of existing steel production that these technologies would be able to substitute for

7. Plant location choice

If EU producers' costs of production increase significantly due to carbon costs, they may consider relocating production to a location where they don't face these costs.

7.1 What are the key factors that EU steel producers take into account when considering relocating plants (or new investments) in non-EU countries?

- Margins of competitors supplying the EU
- Barriers to entry
- Ease of doing business
- Other?

7.2 Consider global producers like Arcelor-Mittal. How should we think about barriers to relocation given that these companies have operations all over the world?

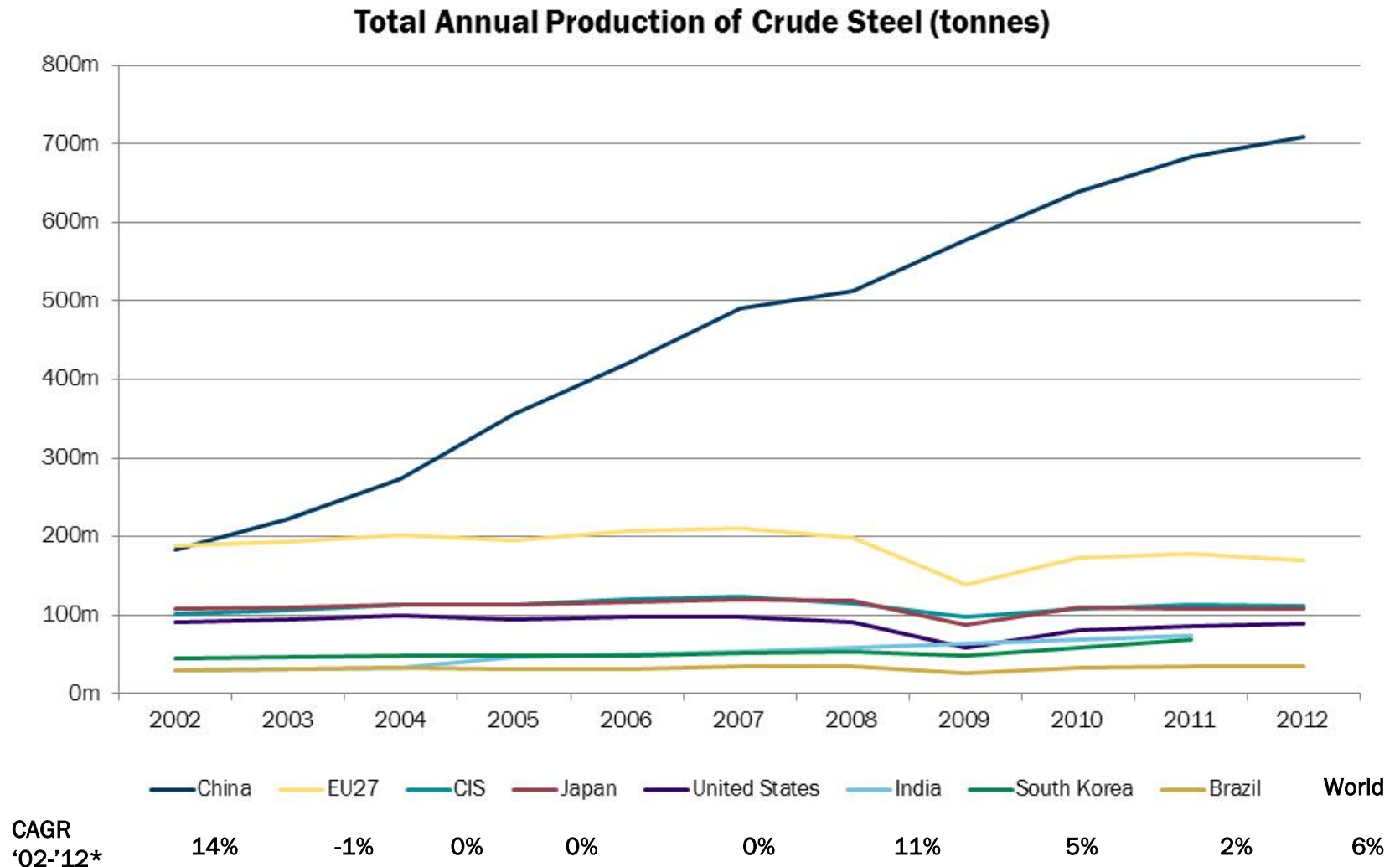
7.3 Can you give us examples of companies relocating and supplying the EU from a non-EU location?

Questionnaire

Difference in expected long-term EBITDA profit margins between EU and other country	% of EU production relocating to the non-EU country
3%	
5%	
10%	
15%	
Other?	

Steel sector competitiveness

Global production of steel has grown at a 6% CAGR since 2002, largely driven by China growing at 14%



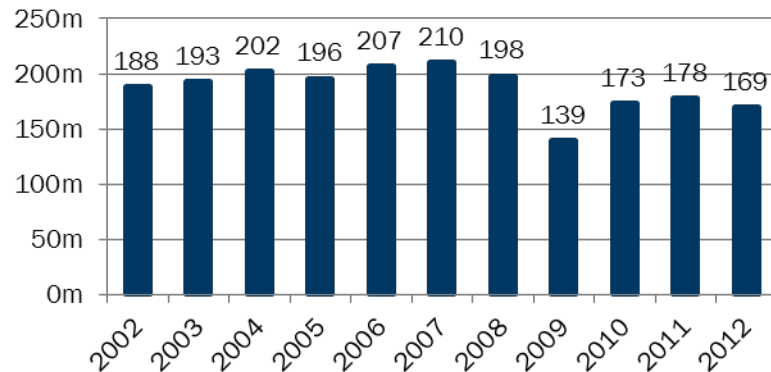
Source: World Steel Organization

* CAGRs for India, South Korea and World are for 2002-2011

Note: Crude steel is defined as steel in its first solid (or usable) form: ingots, semi-finished products (billets, blooms, slabs), and liquid steel for castings. This is not to be confused with liquid steel, which is steel poured.

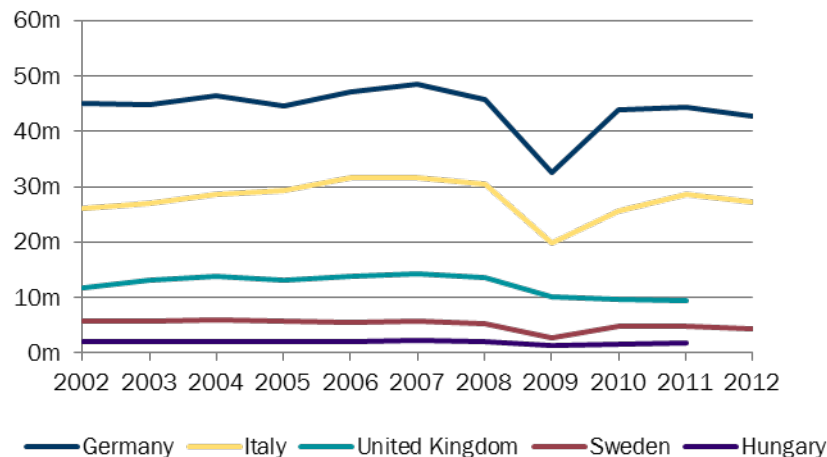
The EU steel production was ~170 million tonnes in 2012, down from 200 million tonnes pre-recession

EU 27 Production of Crude Steel, 2002-2012



- Steel production volume fell by 20 per cent during the recession, from the peak of 210 million tonnes in 2007 to 170 million tonnes in 2012

Total Annual Production of Crude Steel

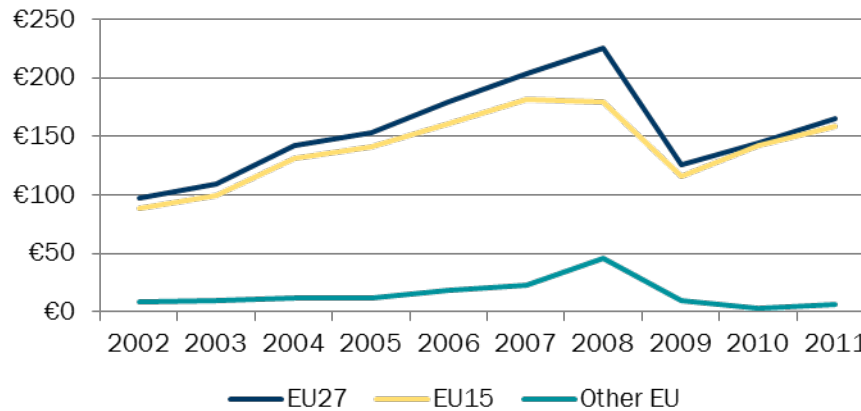


- The impact of the recession varied across regions. The larger producers experienced a smaller decline in production:
- Germany's volume declined by 12% and Italy's by 14% between 2007 and 2012
- The UK, Sweden and Hungary saw 34%, 24% and 22% decline in production since 2007, respectively. (Note: data for the UK and Hungary are only available up to 2011)

Source: Eurofer

Sharp increase in turnover until 2008 was followed by a dramatic decline in 2009 and a partial recovery in 2010-11

Aggregate turnover in the EU iron and steel industry (€ billions)

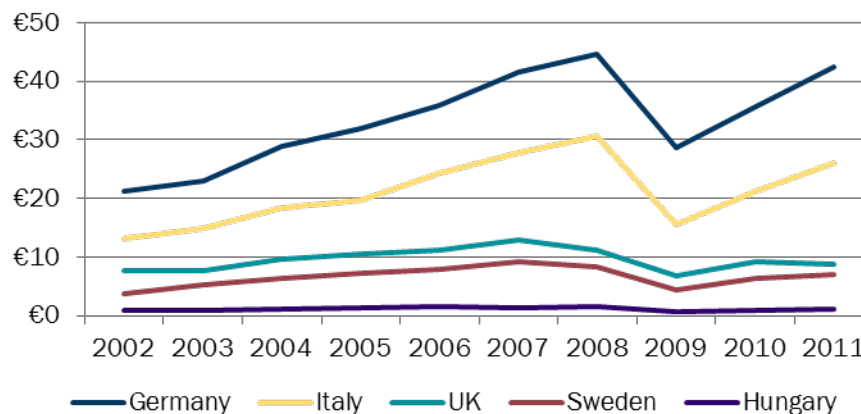


- Between 2002 and 2008, turnover of the EU's steel industry increased at a 15% CAGR
- The increase in turnover significantly exceeded the growth in production, which increased by a 2% CAGR between 2002-07
- The increase in turnover was primarily driven by an increase in raw material prices reflected in steel prices and did not translate into significantly higher profitability for steel producers (see later)

"Iron ore moved from \$35/ton 2004, to \$200/ton in 2008, then went back in 2009 to \$85 and bounced back in 2011 to \$200"

Former Director of Steel Research, Metal Bulletin

Aggregate turnover in the iron and steel industry by country (€ billions)

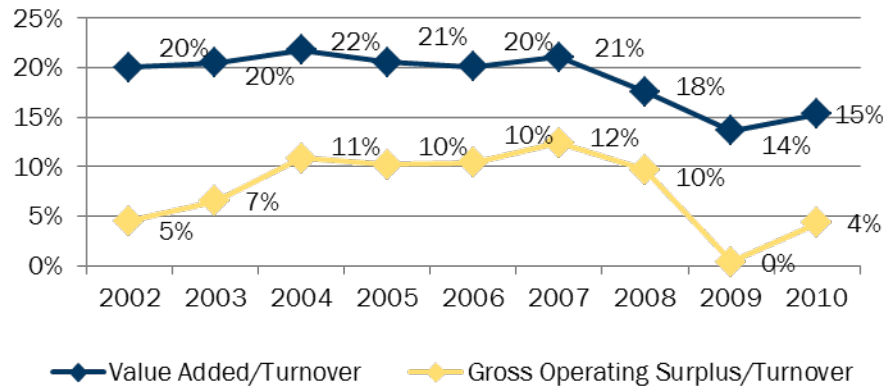


Source: Eurostat

- The EU's turnover declined by 44% from 2008 to 2009. Turnover was still 26% below the peak in 2011
- Individual countries saw their turnover decline and recover to different extent
- Turnover in Germany declined by 36% in 2009, but it almost completely recovered by 2011
- Hungary's turnover fell by nearly 60% in 2009 and was still 30% lower in 2011 than at the peak

Gross margins were above 20% and EBITDA at 10%-12% pre-recession; margins squeezed significantly during the downturn

Margins in the EU iron and steel industry, 2002-2010

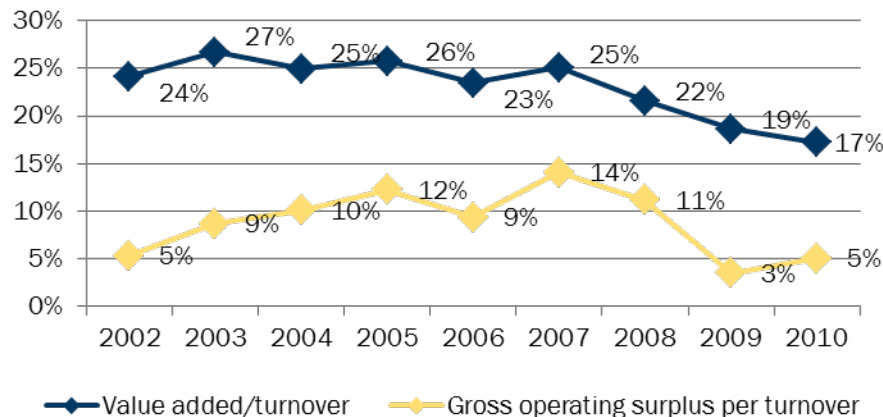


■ EBITDA margins in 2011-2012 continued to be depressed:

"In the last two years Italian EAF mills were operating at 1% EBITDA. Spanish EAF mills are closing down, going bankrupt... For BOF: the first semester this year, Salzgitter made a loss of €300 million on 4 million ton production. ArcelorMittal and TATA have similar numbers. EU producers have been losing 10-15% of their turnover value."

Former Sales Director, Duferco

Margins in the German iron and steel industry, 2002-2010



Source: Eurostat

■ EBITDA margins vary considerably across regions and producers:

"German mills are making much higher margins, e.g. 100 euro/t EBITDA for Dillinger, while mills producing commodity products, e.g. the Italian plants including Riva will make less than 50 euro/ton."

Former Director of Strategy, ArcelorMittal

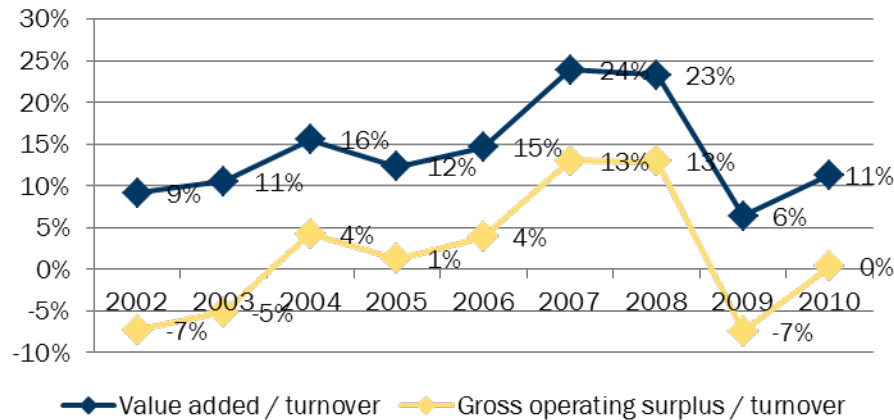
"The lowest cost producer is Ijmuiden [Tata Steel] in Northern Netherlands, and the highest cost would be Salzgitter in Germany – they import iron ore, barge it down the Rheine, high internal transit costs, high power costs and labour costs, they don't have their own coke. Their strategy is not hot rolled coil but premium galvanized cold coil."

Former Director of Steel Research, Metal Bulletin

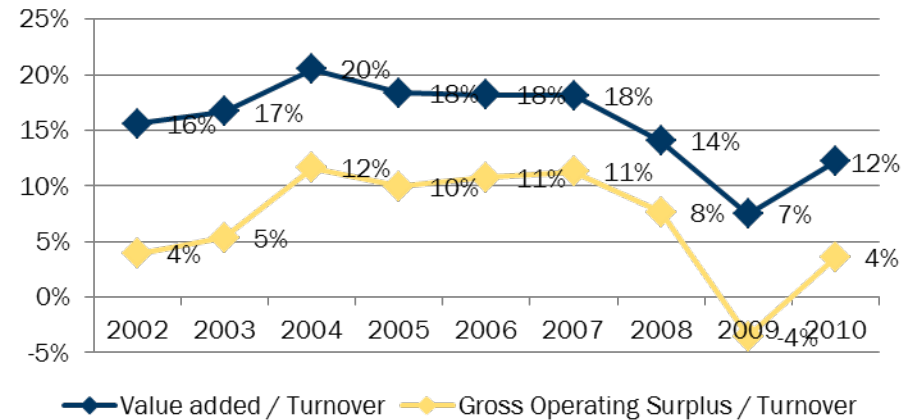
Note: Value added / turnover is indicative of gross margins, Gross operating surplus / turnover is indicative of EBITDA margins

Margins are cyclical and vary considerably across regions

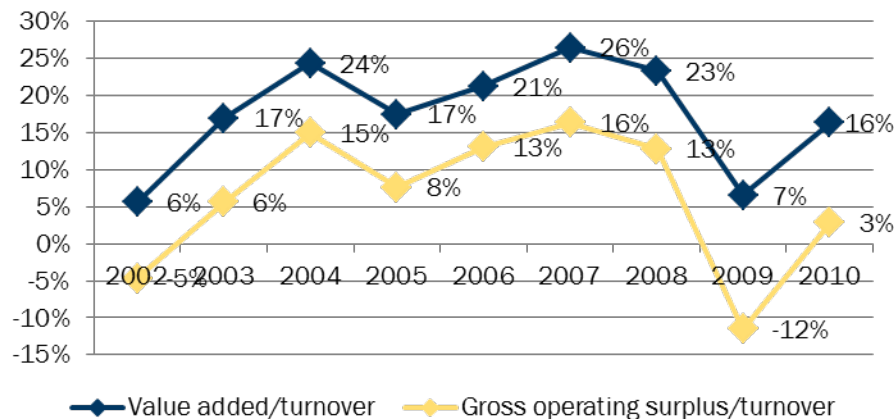
Margins in the UK iron and steel industry, 2002-2010



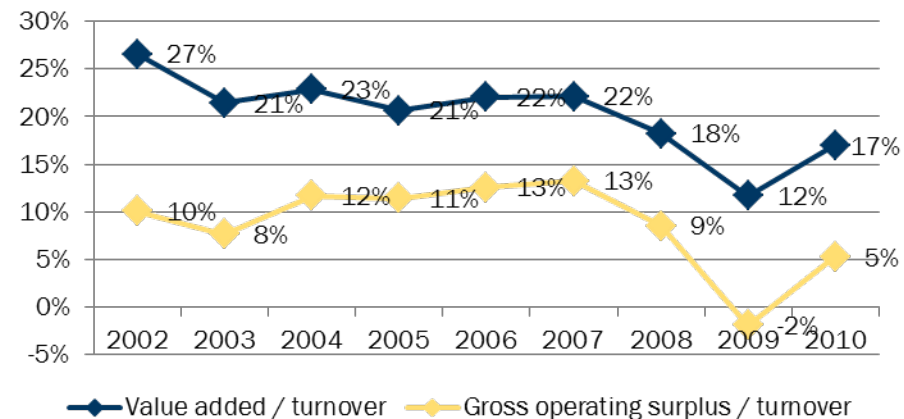
Margins in the Italian iron and steel industry, 2002-2010



Margins in the Hungarian iron and steel industry, 2002-2010



Margins in the Swedish iron and steel industry, 2002-2010



Note: Value added / turnover is indicative of gross margins, Gross operating surplus / turnover is indicative of EBITDA margins

Source: Eurostat

COMPASS LEXECON

Low EBITDA margins are primarily a result of intra-European and not of external competition

Overcapacity at recent domestic demand levels intensifies intra-EU competition

"It is mainly the Europeans that are killing each other, the impact of that 10% import on the price is limited. They are going bankrupt because there is capacity for 200 million, this capacity might have even increased in the past few years. ArcelorMittal said we don't have the market, we are going to close down the plant in Florange, French minister was screaming in television. We need to take out capacity. This is what has to take place either by some of the bigger groups deciding to do it or by the market forcing out some plants."

Former Sales Director, Duferco

The industry is not yet consolidated, lots of producers compete for reduced demand

"Europe is very competitive. ArcelorMittal, for example, is operating at very low margins. ArcelorMittal said this is not sustainable, we have to raise prices. It is not easy because others don't follow. This is why there is no cartelisation in this industry. There have been recent announcements of price increases, but then the Italian mills don't follow, and then what happens is this company loses volume and this is very much a volume game. Competition inside Europe determines prices. You have lots of producers, because the industry is not yet consolidated."

Former Director of Strategy, ArcelorMittal

Mills try to place volume even at negative margins

"Some mills run at negative net margins to get more volume."

Former Sales Director, Duferco

"Steel is a volume business, you lose a bit of volume and your fixed costs become unmanageable."

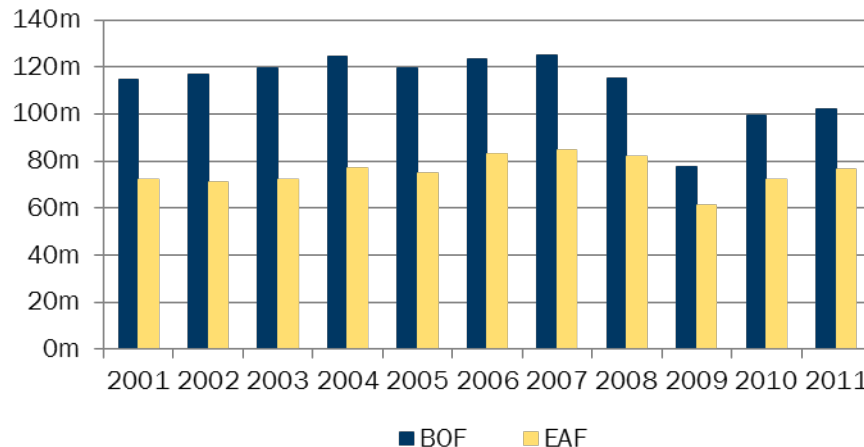
Former Director of Strategy, ArcelorMittal

Two types of technologies are used in European steel production, Blast Oxygen Furnace and Electric Arc Furnace

	Blast Oxygen Furnace (BOF)	Electric Arc Furnace (EAF)
Description	Emission intensive process which reduces iron ore into basic iron	Electricity intensive process using scrap metal
Final product	Typically 'flat' products	Typically 'long' products but increasingly flat products
Carbon intensity	High direct emissions Lower indirect emissions	Minimal direct emissions Higher indirect emissions
Volume of typical plant	5mn tonnes	1mn tonnes
Investment cost	\$4.0bn	\$0.5bn
Innovation	Operating at efficiency limit of energy consumption	Increasingly substitute for BOF as a producer of high quality steel

BOF continues to be dominant but the share of EAF has grown from 38% in 2001 to 43% in 2011

Steel production by technology, EU27, 2001-2011



Source: World Steel Organization

■ The EAF technology emits significantly less carbon, about 0.1 tonne of carbon per ton of steel, than the BOF technology, which emits 2 tonnes of carbon per tonne of steel produced

■ Further growth of EAF appears constrained:

“Depends on technology and raw materials. The most modern EAFs can produce 95% of BOF products, but the capex for that is very high and have to use a high proportion of virgin materials.”

Former Director of Steel Research, Metal Bulletin

“The availability of scrap gives limits. A sharp increase in EAF production would boost scrap prices and kill a big proportion of the advantages.”

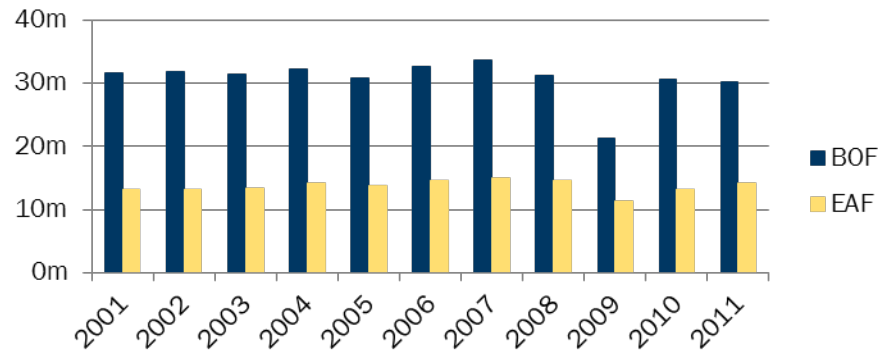
Former Head of Stainless Steel Division, Stemcor

“I don’t believe in switching to more EAF technology. It is mostly used for long products, for lower quality types of steel. For the higher quality business you have to control your parameters, it is like in the chemistry shop. Then you don’t have the volume in an EAF plant; automotive, for example, needs volume. You also have to look at the total cost of ownership: for someone who owns a BOF plant, to invest in a new EAF plant and shut down the initial BOF, I’m not sure the carbon savings will make this economical.”

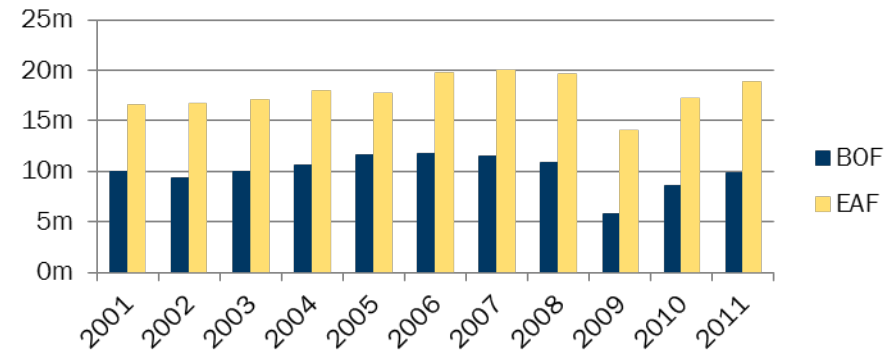
Former Director of Strategy, ArcelorMittal

Shares of BOF and EAF vary significantly across countries

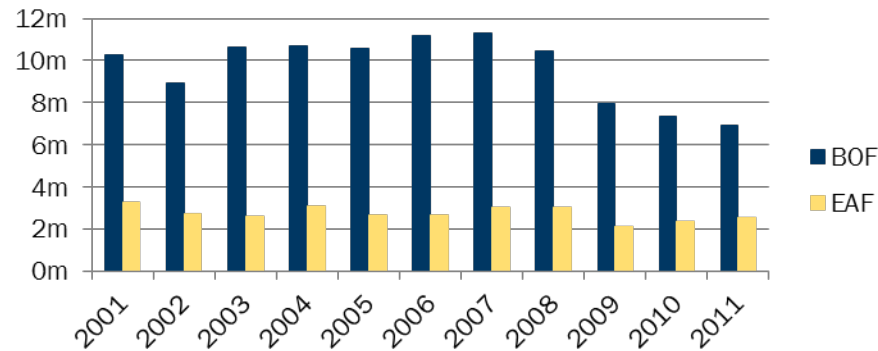
Germany



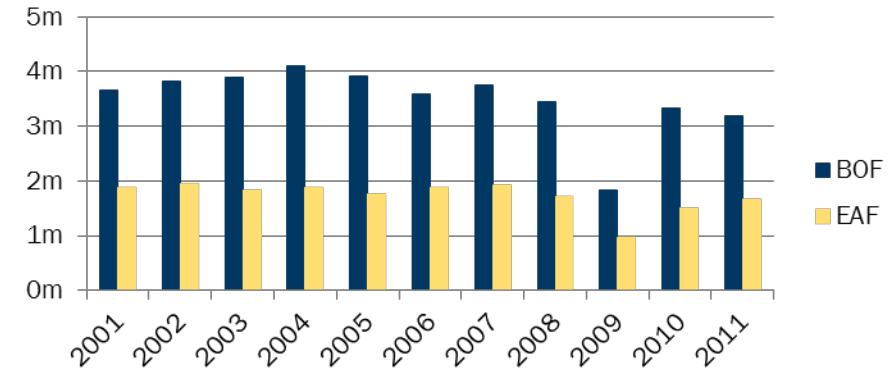
Italy



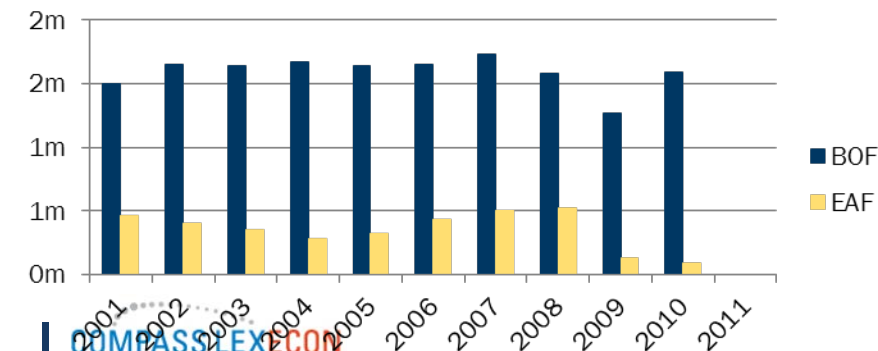
United Kingdom



Sweden



Hungary



Source: World Steel Organization

Minimum long-term EBITDA margin for a BOF plant is 10%, for an EAF plant 8-9%

Plant type	Minimum EBITDA margin
Blast Oxygen Furnace	10%
Electric Arc Furnace	8-9%

- Despite large differences in depreciation, experts indicated that minimum margins for a BOF plant is only slightly higher than for an EAF plant:

“Minimum EBITDA margin necessary for long term viability depends on the firm. E.g. Salzgitter, Thyssen or Arcelor have to compete for financing, some more niche companies being helped by foundations, they need lower levels of profitability. At the end of the day, investors are comparing their investments with something like Siemens. A long run 10% is the minimum, but more like 12-13% for the larger ones.

A lot of BOFs are public, many EAFs are middle sized or in family charges, these are more modest concerning their earnings expectations. Keep in mind that in China the big competitors have new equipment, new furnaces, built by European engineering companies. In Europe you have old equipment, to keep up and generate economies of scale you need to invest more.”

Former Head of Stainless Steel Division, Stemcor

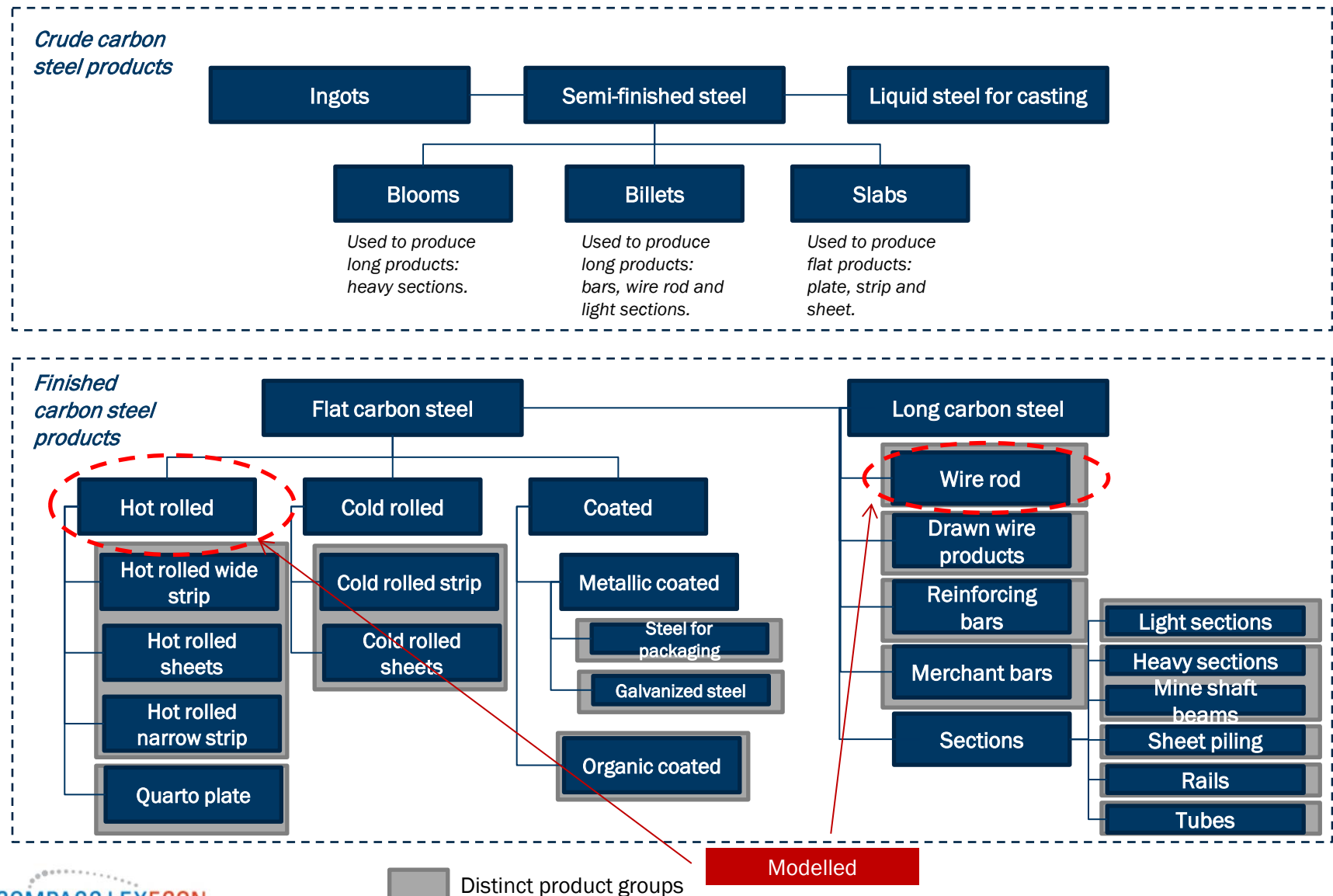
“Long term viability requires a 10% EBITDA at the minimum.”

Former Director of Steel Research, Metal Bulletin

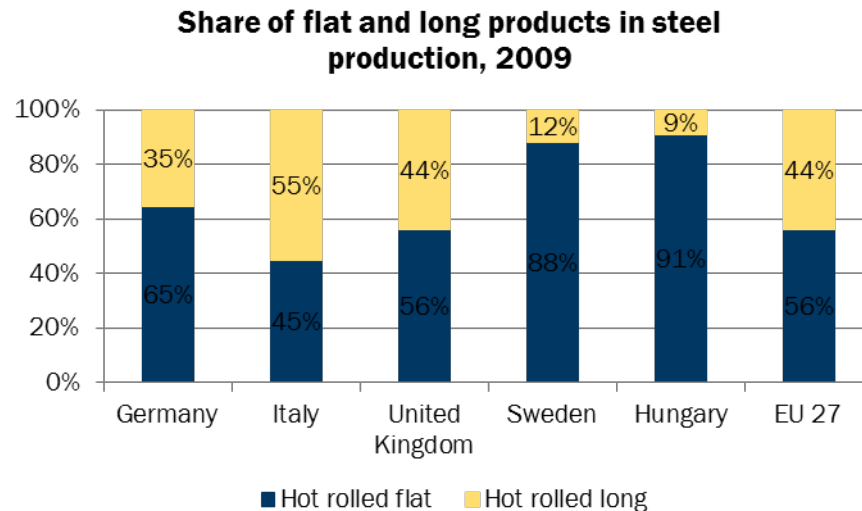
“In order to finance investment you would need at least 2% net profit, 4% before taxes, 8-9% EBITDA margin for EAF.”

Former Sales Director, Duferco

The European Commission distinguishes at least 15 finished carbon steel products



Share of flat products is approx. 60% in the EU; there is wide variation across regions



- During 2001-2011 the share of flat products in the EU 27 countries was consistently around 60%
- In 2009, for which the latest complete country level data is available from Eurostat, this proportion was slightly lower at 56%
- Typically, EAF technology is used to produce more long products

Note: "Hot rolled products (hot rolled long products, hot rolled flat products, seamless tubes) are products of first transformation. These products may be further worked to produce cold rolled-, coated-, and tubular products (except seamless tubes)."

Source: World Steel Organisation

Both flat and long products have specialty and commodity segments; commodity is more exposed to import competition

Product type		Example
Flat products	Specialty	Automotive body parts
	Commodity	Tubular for construction
Long products	Specialty	Wire for engineering
	Commodity	Wire rod mesh and rebars for construction

- Steel experts indicate that commodity products are more exposed to import competition and the share of commodity is larger for long products than for flat products:

“Hot rolled coil, cold roll, coated – from European quality mills, e.g. ArcelorMittal or Salzgitter, is around 30-40%. It is difficult for Asians or other low quality types to compete in the premium segment. 30-40% might be accessible [intermediate segment], 30% is really pure commodity.”

For EAF the commodity part is higher, so probably the specialty is 20-25%, and commodity about 40%.”

Former Head of Stainless Steel Division, Stemcor

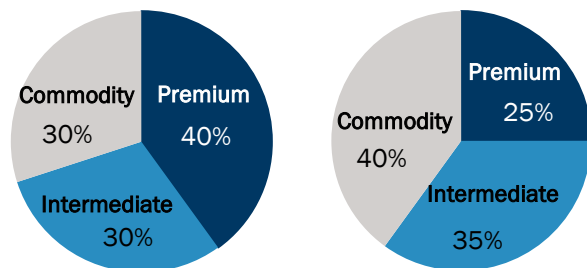
“Most of the import will be of lower grades, that’s the area that is most vulnerable to substitution.”

Former Sales Director, Duferco

“Some flat products e.g. auto buyers will have very high specs with quality very important, but others such as tubular for construction applications will have low quality, but high specs. For longs, some engineering rod will be very high quality, but rebar is not.”

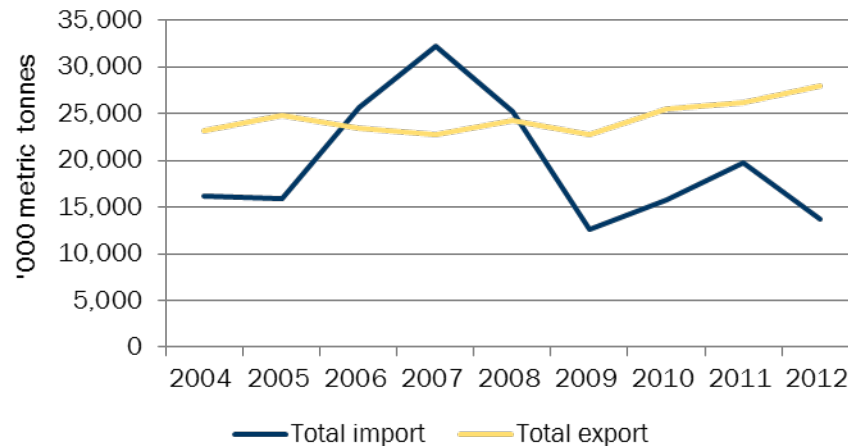
Former Director of Steel Research, Metal Bulletin

Flat products by grade Long products by grade

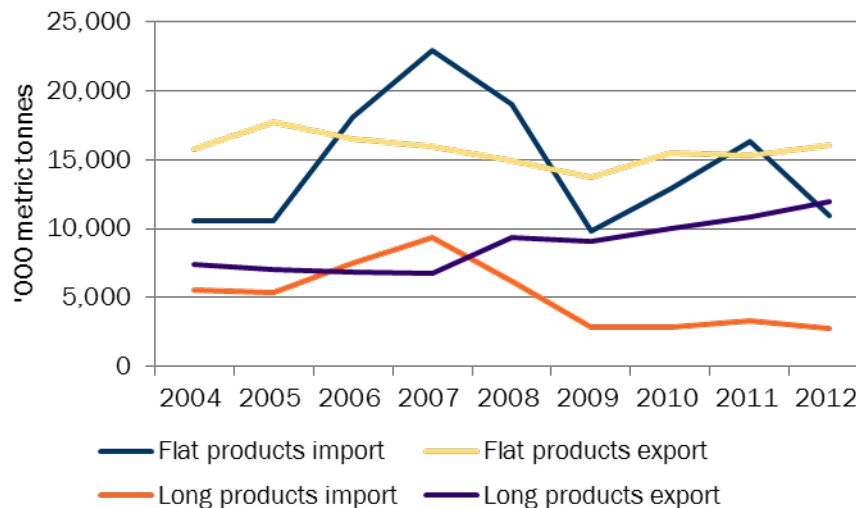


EU has been net exporter during most of 2004-12, trade in flat products significantly exceeds trade in long

EU export and import of finished steel products, 2004-2012



EU export-import, flat and long products, 2004-2012



Source: Eurofer

COMPASS LEXECON

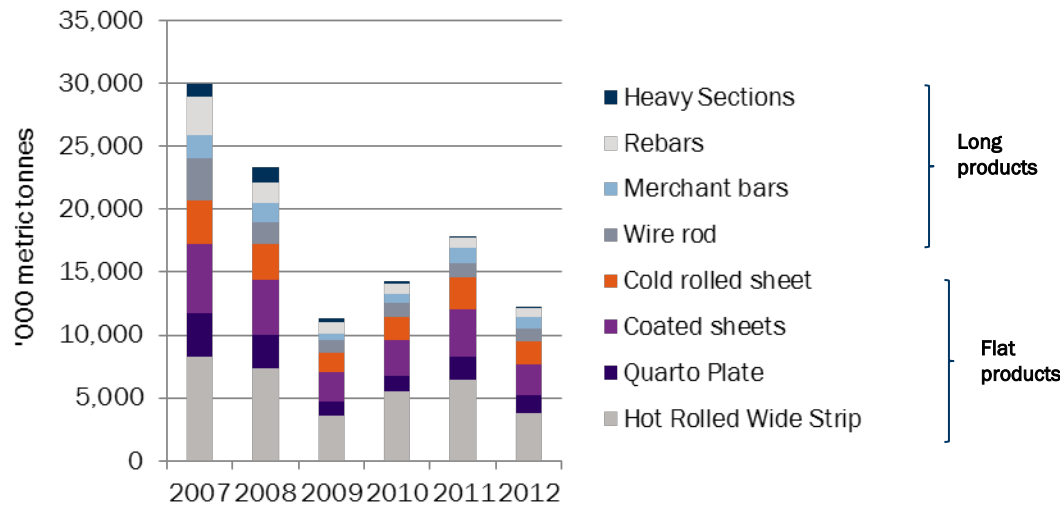
- During 2004-12 total export has grown steadily while import showed large fluctuations
 - Export grew by 2% CAGR in the period
 - Import doubled between 2004-2007, from ~15 million metric tonnes to over 32 million metric tonnes
 - In the period 2006-2008, the EU has become a net importer possibly indicating EU capacity constraints
- Flat products continue to dominate in our export but the gap between flat and long is closing
 - Share of flat decreased from 68% to 57%
- Flat products also dominate in import and share of flats has increased from 65% in 2004 to 80% in 2012
- China's, India's and South Korea's shares in EU finished steel import have not grown since 2007 despite their fast growing production

Country's share in EU's finished steel import:

Country	2007-09	2010-12
China	20%	21%
Russia	11%	14%
Ukraine	7%	14%
Turkey	12%	9%
South Korea	7%	7%
India	6%	6%

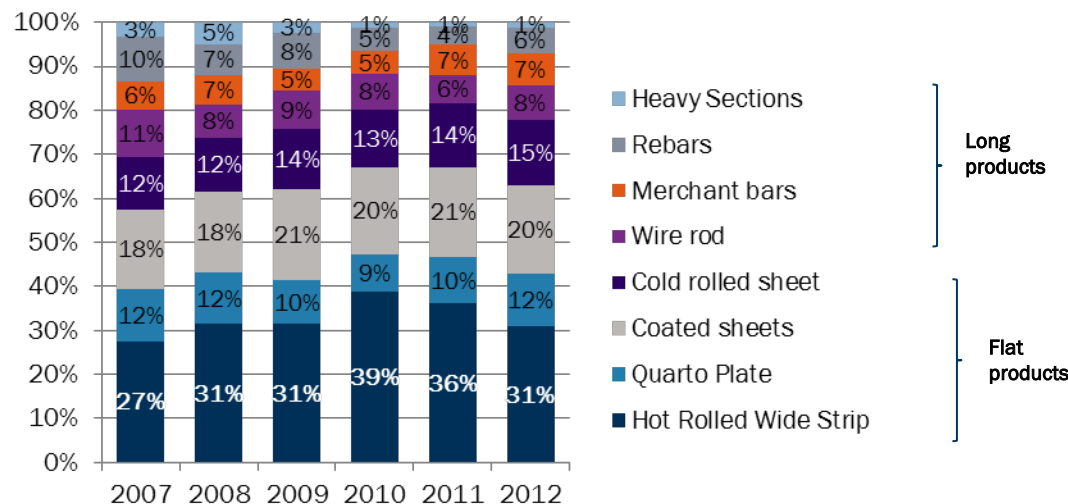
Largest import product categories are hot rolled wide strip, coated sheets, cold rolled sheets and quarto plate

Finished steel import by product, 2007-2012



- Imports of finished steel more than halved since 2007
 - As explained earlier, 2007 was a peak year and the volume of 2012 import is in line with the volume witnessed pre-boom (in 2004)

Finished steel import by product, 2007-12



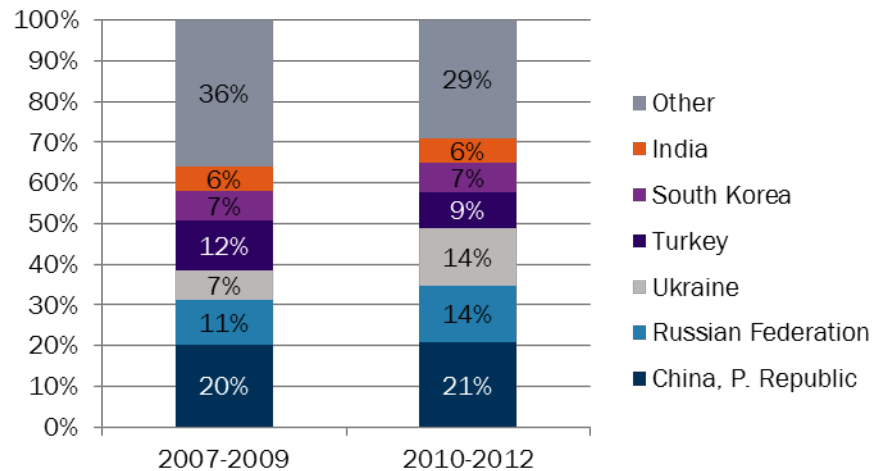
- The top import products are all flat products: in 2012 hot rolled wide strip accounted for 31% and coated sheets for 20%, followed by cold rolled sheets at 15% and quarto plates at 12%
 - Every flat product has increased its share since 2007
- The largest long products are wire rod, merchant bars and rebars – with similar 6-8% shares in 2012
 - Heavy sections have a significantly smaller share at 1%
 - Shares of long products have been falling except for merchant bars that increased slightly in the 2007-12 period

Source: Eurofer

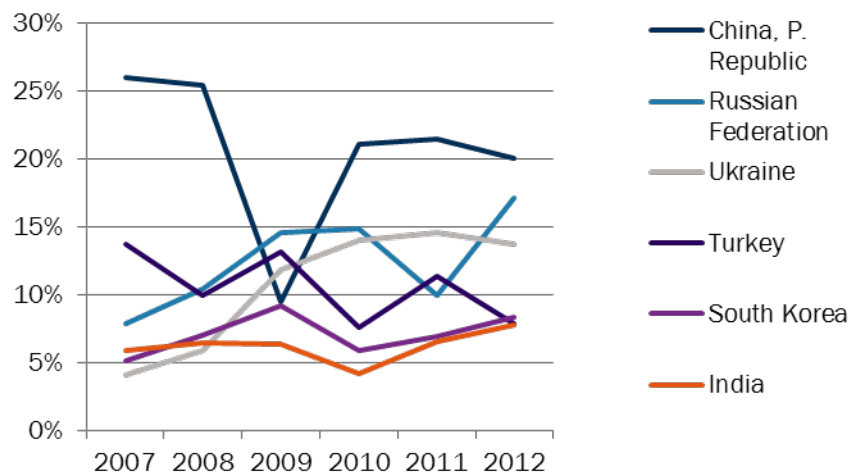
COMPASS LEXECON

In 2010-2012 over 70% of EU finished steel import was from 6 countries: China, Russia, Ukraine, Turkey, S. Korea and India

Share of countries in EU finished steel import, 2007-2012



Share of countries in EU finished steel import, 2007-2012



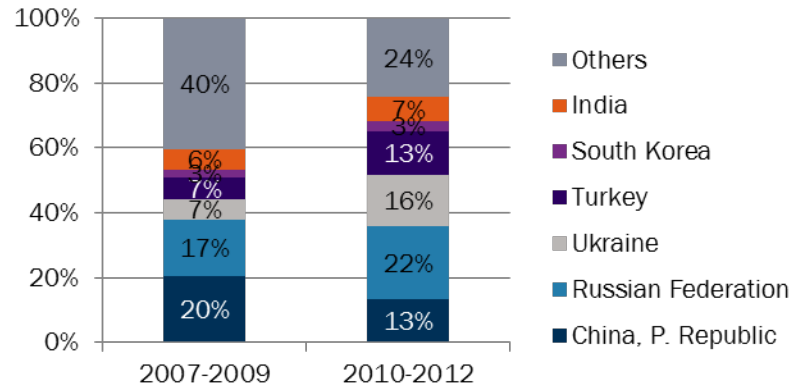
- The 6 countries' share in total import rose from 64% in the 2007-2009 period to 71% in the 2010-2012 period
 - China is the biggest importer but it's notable that its average share did not change significantly during the observed period
 - In the same period, Ukraine's market share doubled and Russia's increased by 3% point
- The shares of individual countries in total import vary significantly year by year, e.g.:
 - China's share was 25% in 2008, 10% in 2009 and 21% in 2010
 - Russia's share was 15% in 2010, 10% in 2011 and 17% in 2012
- The volatility of shares is also observed in the product level data:
 - China's share in quarto plate fell from 60% in 2007 to 19% in 2010 and went back to 45% in 2012
 - Ukraine's share in the same period rose from 11% in 2007 to 43% in 2010 and fell back to 19% in 2012

Source: Eurofer

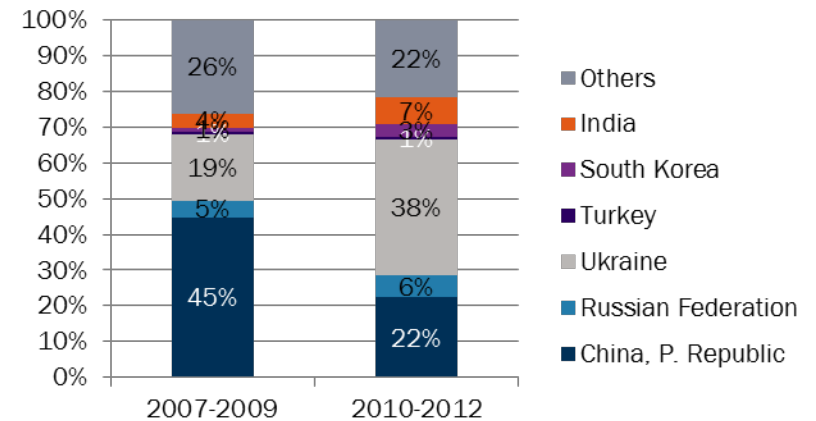
COMPASS LEXECON

China has a strong presence in all flat products; the others tend to concentrate on 1 or 2 products

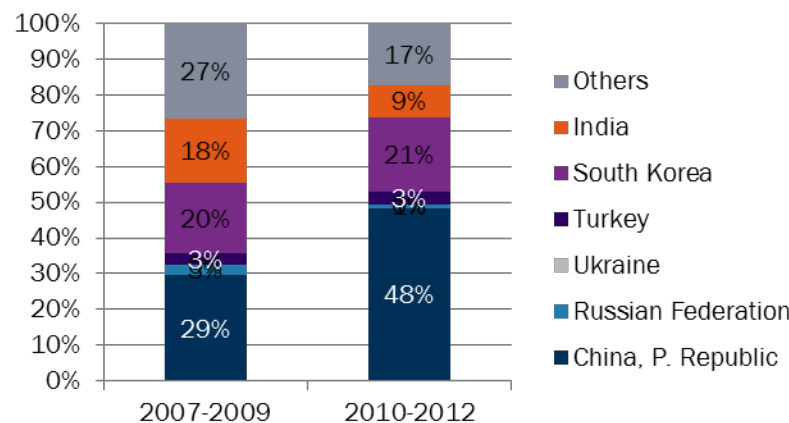
Hot rolled wide strip, EU import from third countries, 2007-2012



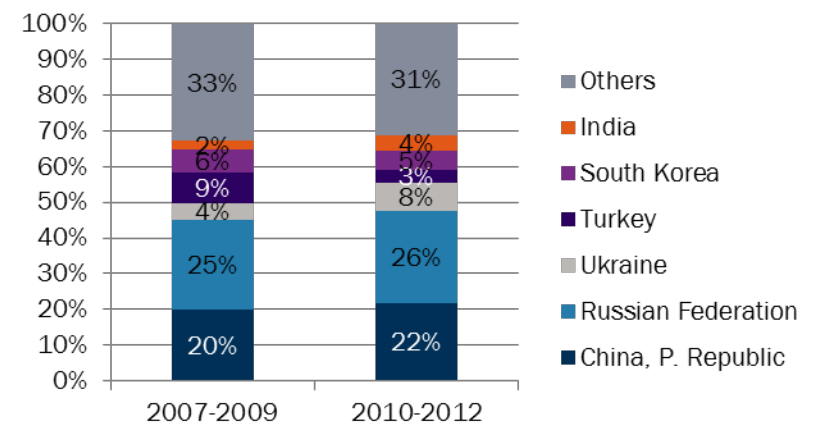
Quarto plate, EU import from third countries, 2007-2012



Coated sheet, EU import from third countries, 2007-2012

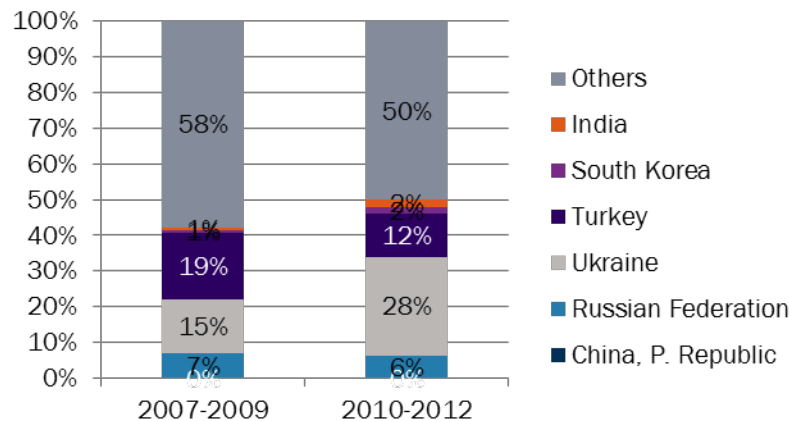


Cold rolled sheet, EU import from third countries, 2007-2012

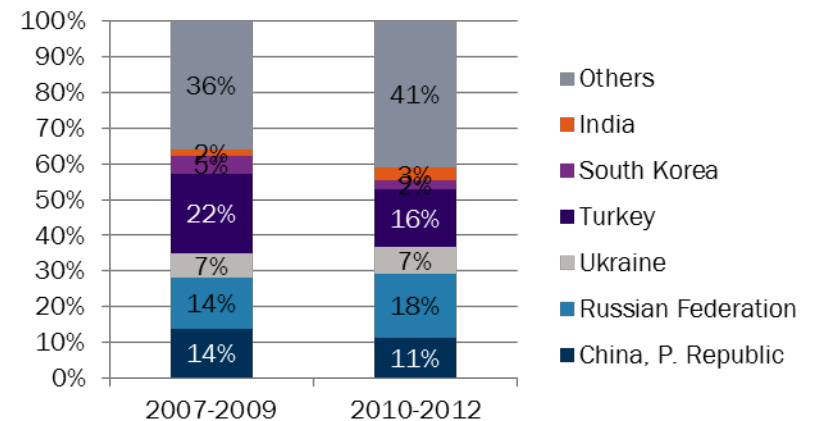


The long product import is dominated by Turkey and Ukraine; South Korea has a strong presence in heavy sections

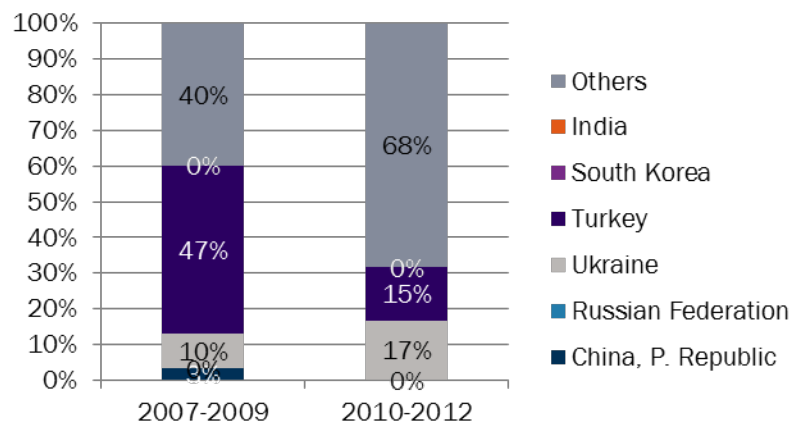
Wire rod, EU import from third countries, 2007-2012



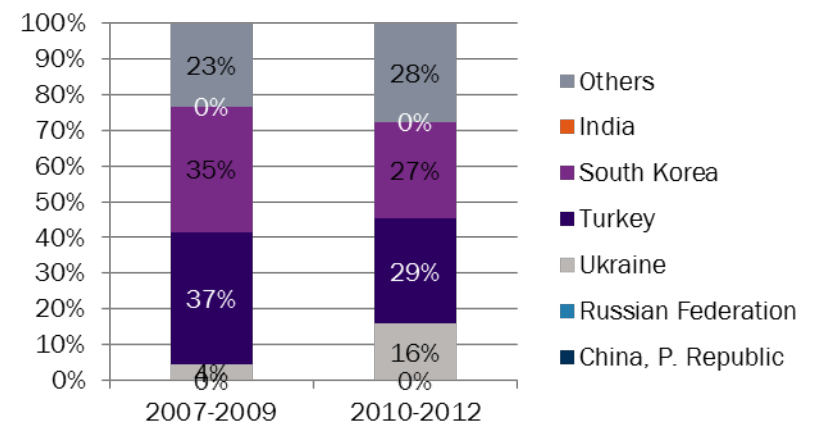
Merchant bar, EU import from third countries, 2007-2012



Rebar, EU import from third countries, 2007-2012



Heavy section, EU import from third countries, 2007-2012

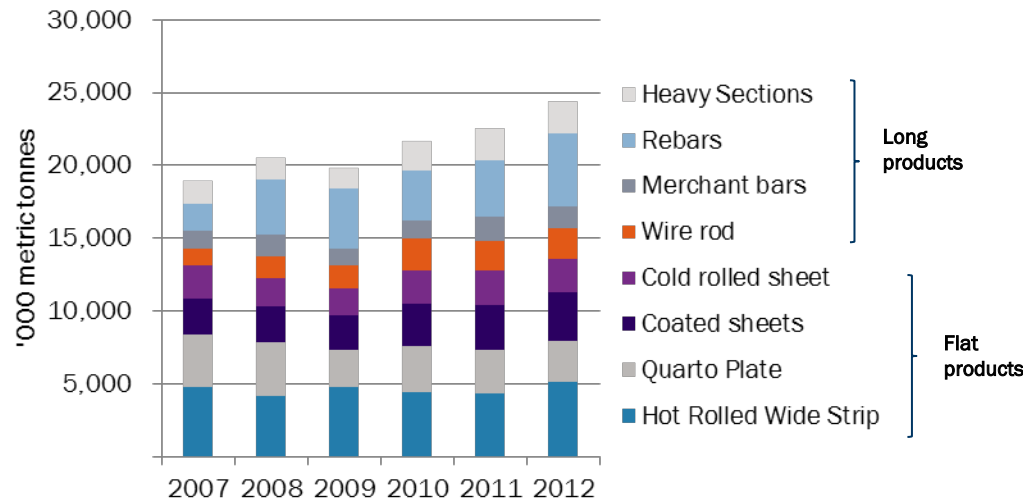


Source: Eurofer

COMPASS LEXECON

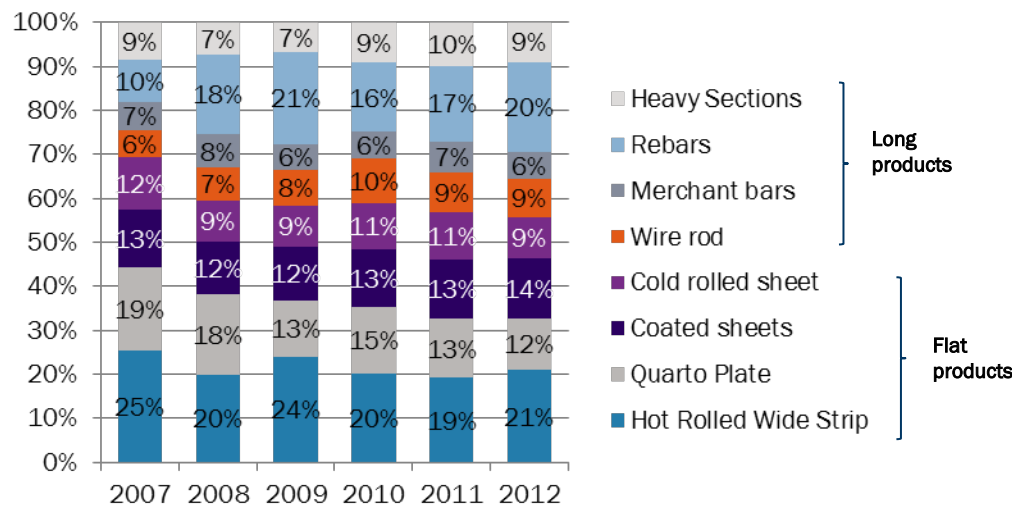
Share of flat products in EU exports declined from 69% to 54% between 2007-2012

Finished steel export by product, 2007-2012



- Exports of finished steel have increased at 5% CAGR between 2007-2012

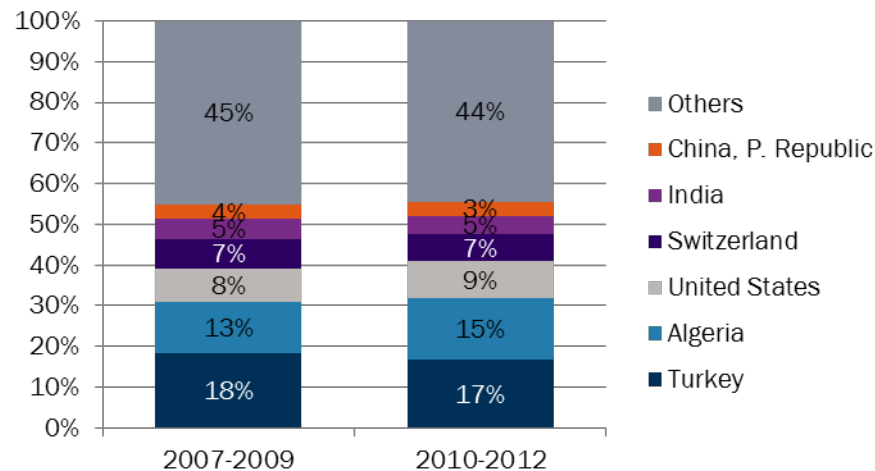
Finished steel export by product, 2007-2012



- The largest export products in 2012 were hot rolled wide strip (21%) and rebars (20%)
- Long products have been gaining share in EU exports:
 - Rebars' share doubled between 2007 and 2012, from 10% to 20%
 - At the same time, the share of quarto plates declined from 19% to 12% and the share of hot rolled wide strip fell from 25% to 21%

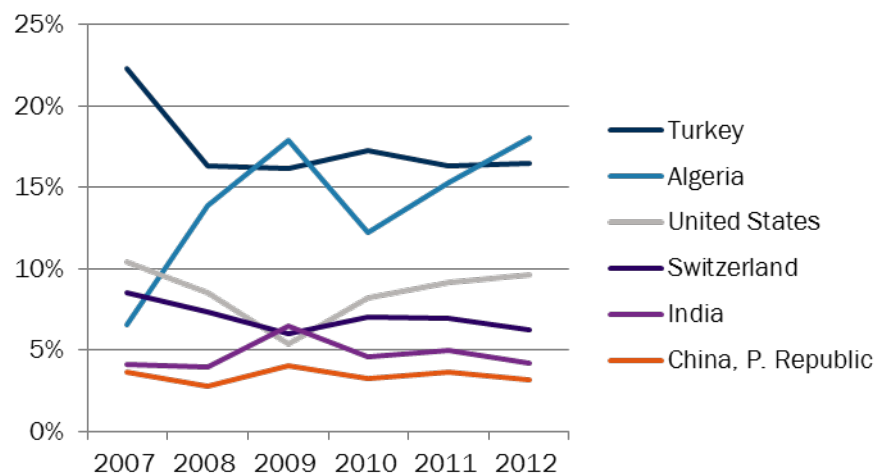
The EU's largest export destinations are Turkey and Algeria, followed by the US and Switzerland

Share of countries in EU finished steel export, 2007-2012



- The top 6 countries' share in total export remained largely unchanged from the 2007-2009 period to the 2010-2012 period
 - Turkey tends to be the largest export destination, closely followed by Algeria

Share of countries in EU finished steel export, 2007-2012



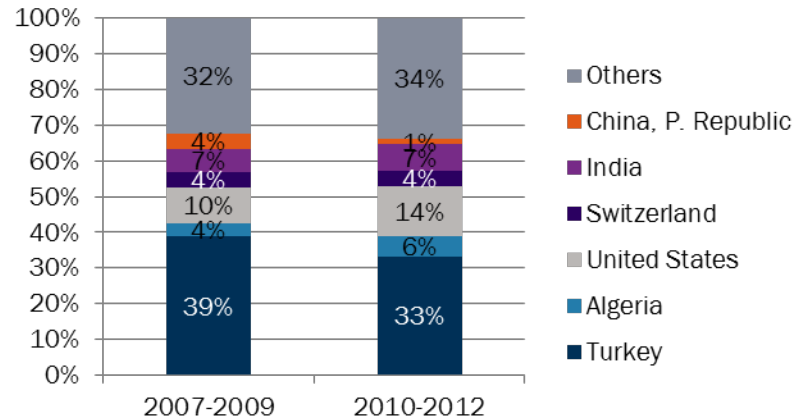
- Some volatility of market shares is observed but significantly less than in the case of import:
 - Algeria's share was 7% in 2007, 18% in 2009 and 12% in 2010 and 18% in 2012

Source: Eurofer

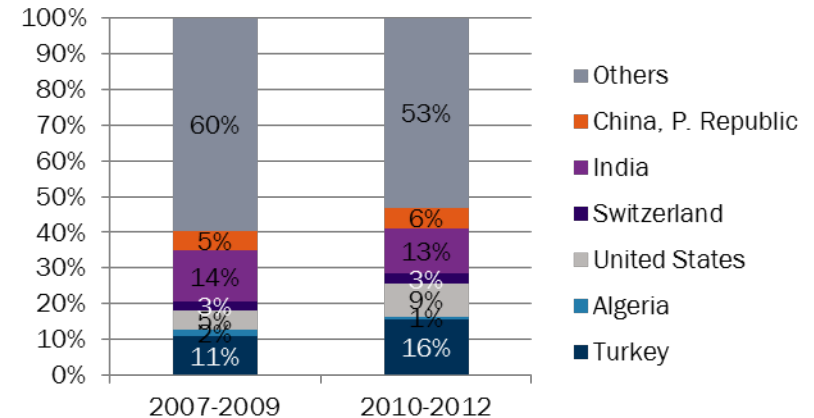
COMPASS LEXECON

Turkey and the US are top destinations for all flat products; India for quarto plate and Switzerland for cold rolled sheet

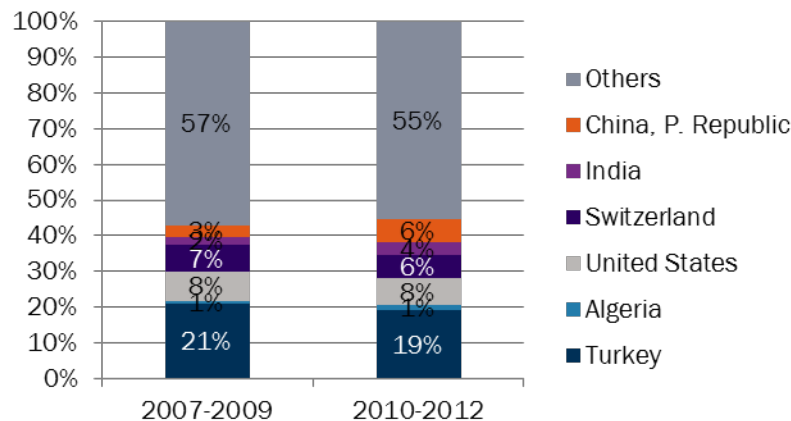
Hot rolled wide strip, EU export to third countries,
2007-2012



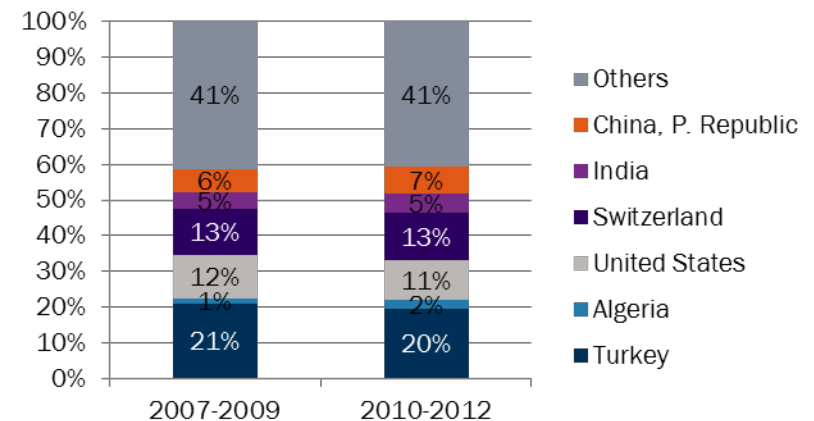
Quarto plate, EU export to third countries,
2007-2012



Coated sheets, EU export to third countries,
2007-2012

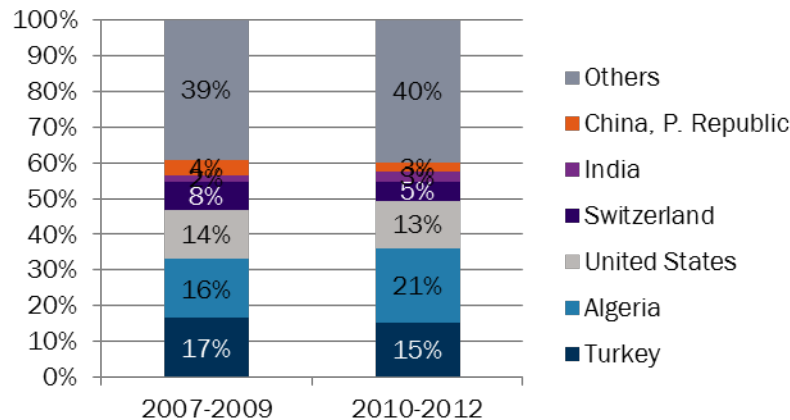


Cold rolled sheet, EU export to third countries,
2007-2012

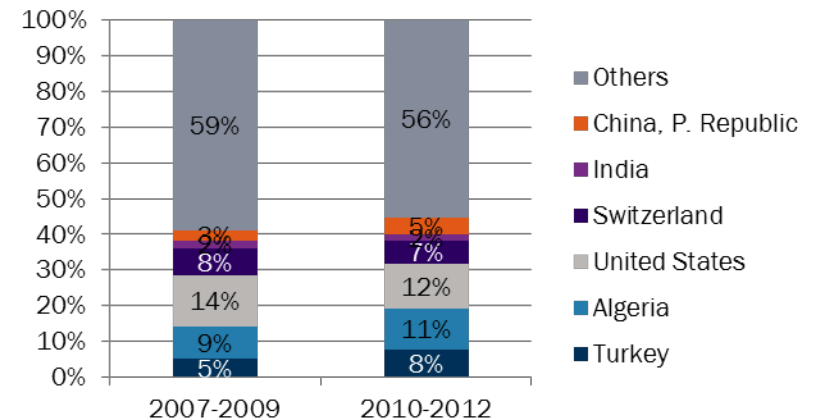


Algeria is the top destination for wire rod and rebars; the US, Switzerland and Turkey are also key buyers of long products

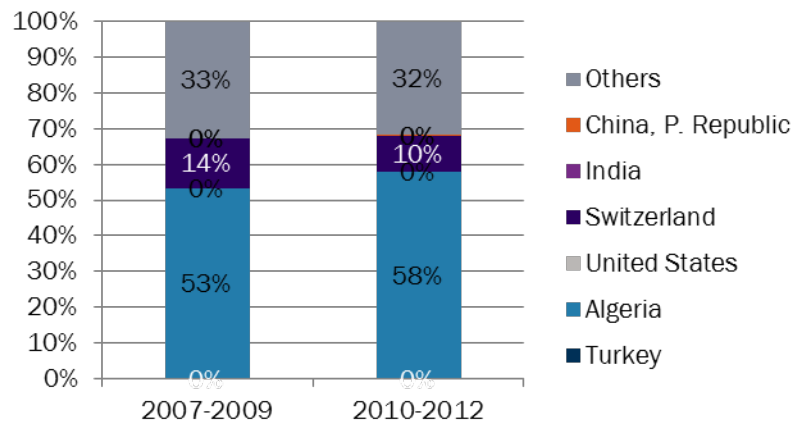
Wire rod, EU export to third countries, 2007-2012



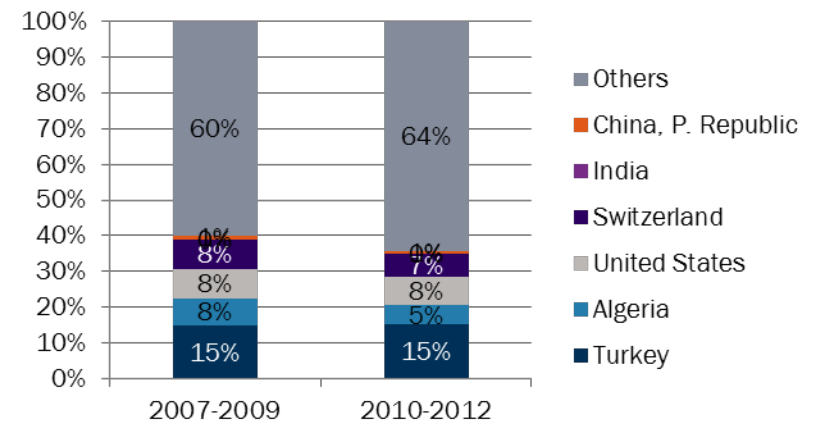
Merchant bars, EU export to third countries, 2007-2012



Rebars, EU export to third countries, 2007-2012

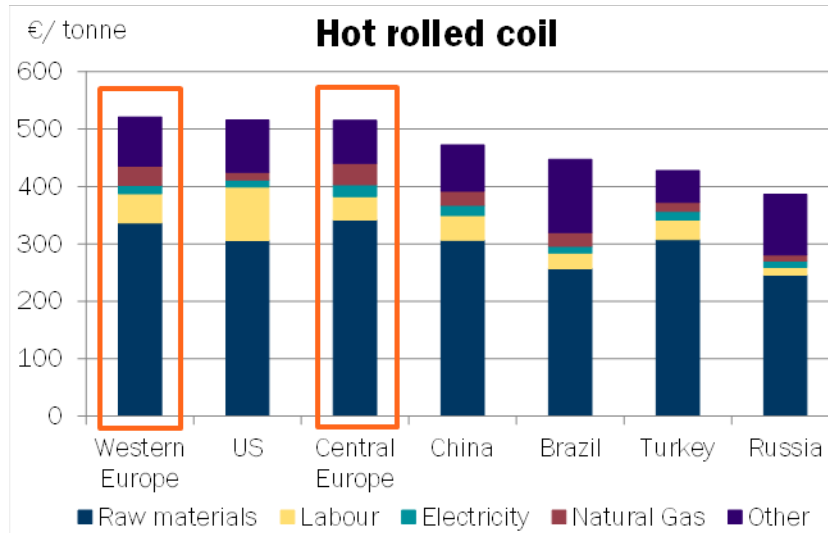


Heavy sections, EU export to third countries, 2007-2012

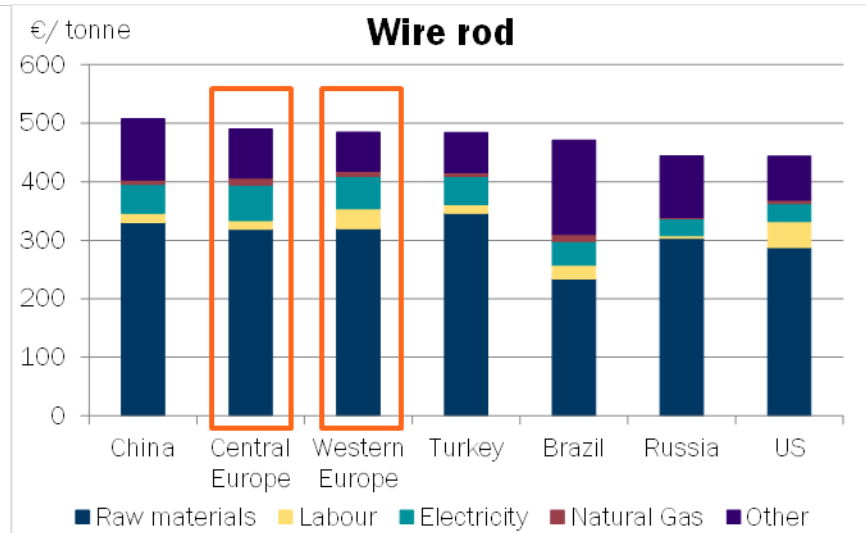


European plants were among the highest cost producers in 2012

BOF



EAF



Source: Assessment of Cumulative Cost Impact for the Steel Industry, Center for European Policy Studies (based on World Steel Dynamics data)

Country	% difference vs. least-cost producer
Western Europe	35%
Central Europe	33%

Cost difference primarily driven by:

- Raw material cost (EU has the highest)
- Natural gas costs
- Labour costs

Country	% difference vs. least-cost producer
Central Europe	11%
Western Europe	9%

Cost difference primarily driven by:

- Raw material costs
- Electricity costs

There are several limits to steel import substitution

85% of steel sales is local

“Steel is a fungible product, it can be shipped, it can go around the world. However, 85% of steel sales from a mill are within 300-400kms. You still have a vast majority of steel sold locally; inter-regional flows are in the region of [only] 150 million tons a year. **The opportunity to displace by supplying globally is very limited** and current market conditions are especially not conducive”

Switching suppliers is very difficult due to approval process

“Manufacturing has specific requirements, in terms of grade, in terms of quality. For the big consumers where performance is important, e.g. automotive, industrial equipment, yellow goods, even tubular, you typically see an approval process, **suppliers have to meet standards**. For manufacturing that ability to rely on the quality of steel and just in time manufacturing arrival, is very important. **To extend the supply chain globally is very very difficult to do.**”

Import price has to be 17-18% lower than domestic to be competitive

“For import orders it takes 4 weeks to manufacture, 4-6 weeks to ship, then unloading and delivery, so you have a 10-12 weeks lead time. To work with this lead time you may need to extend working capital, you also got the issue that if there is a problem it is difficult to get replacement, and you are also exposed to price risk movements over an extended period. As import, you are typically going at a 10% discount on a delivered basis. **Steel is a relatively small part of the overall cost, so this doesn't work for most OEMs but for a distributor saving 10% may be worth.** And then you have min. 7-8% transport cost.”

EU producers specialize in high quality products; import is of lower grades

“**Most of the import will be of lower grades**, that's the area that is most vulnerable to substitution...The highest cost producer in Europe would be Salzgitter in Germany. Their strategy is not hot rolled coil but the highest quality, premium galvanized cold coil...ThyssenKrupp in Europe has been very successful; they may only sell 20% to stock market, all else is very specific, high margin to OEMS, abrasion resistant material, where there is no import alternative.”

Minimum transportation cost is around 7-8%

“For example, currently the FOB Russian hot rolled coil price is \$520. To get to Europe from Russia, transportation cost is about \$40. **The minimum transport cost is around 7-8%** [of the landed cost, of \$560]. The cost depends on the route and mode (for example, Turkey to Southern Europe by boat is around €25/tonne, whereas China to Southern Europe is around €45-55/tonne. Larger volumes, or traders that are able to fill a boat may get better rates”

Former Director of Research Metal Bulletin

There is considerable debate over the risk of the steel industry relocating the liquid steel production outside of Europe ...

Debate over the relocation of liquid steel production

*“Mittal’s strategy: in the first step the melting sites in Europe are concentrated on the locations that are in coastal areas. In the future the supply of slabs from other parts of the world will increase. **The concept is brilliant, you produce slabs close to the raw material source. But** unstable political situation, Mittal has been in discussion with India for 20 years, its home country, it is a political issue, no culture, not a safe legal side. **But today we have very few really global steel producers.**”*

Former Head of Stainless Steel Division, Stemcor

“Hot production of slabs and billets could be done in one country (lowest cost) then shipped to another for processing to hot rolled coil and wire rod - within close proximity to market.”

Former Director of Raw Materials, ArcelorMittal

*“NLMK R/ Metinvest UK – these are integrated companies with all of the hot phase in the CIS. They bought some of the plants in Europe and they only use the rolling capacities. They profit from their very low raw material cost – hot phase is the most expensive, that’s where the most material and energy goes – and then they use the know how and capacity of good lines of European mills. Some people think that this is the future of European steel making, but there is a huge economic and political risk to putting production outside of Europe. **I don’t think that the hot part going away is realistic.**”*

Former Director of Strategy, ArcelorMittal

Example of DRI plant attracted to low natural gas prices in the US

“Voestalpine has invested in a direct reduction plant in the US – however this was primarily driven by low natural gas prices.

Former Head of Stainless Steel Division, Stemcor

... however, experts agreed that there are several barriers to relocation

There are no examples of successful relocation

“ThyssenKrupp is the only company that has put capital investment into an overseas market and part of their expectations was carbon would rise. As Brazil was out of the Kyoto, they thought they would save 35 euros a ton. They were building for slab: 5 million tons capacity. They also built a 3-4 million finishing plant in the US, 1-2 million tons were to be shipped to Europe. This was made in 2007, European demand has gone 15-20% down, they don't need the slab in Europe. There have also been huge operational problems and the logistics to USA didn't work.”

Former Director, Research Metal Bulletin

“Since there is no economic competitiveness there are no relocations.”

Former Sales Director, Duferco

“I can't give you an example of steel plant relocating and servicing the EU from another location. It is more associated with reduced production in the EU as they become non-competitive in some areas (especially the hot end) and non-EU plants will fill the void.”

Former Director of Raw Materials, ArcelorMittal

Capex are too high, logistics are too expensive

*“When they [Tata Steel] took over Corus, they were considering building a plant in India and shipping to Europe but they haven't done it. **They considered the capex too high and the logistics too expensive.** They ended up spending 500 million euros upgrading Port Talbot in Europe.*

***Capex of greenfield plants has ballooned over the last few years,** even without cost overruns, 2.5 thousand dollars a ton/capacity – this takes you to 7.5 billion dollars. China is much cheaper. If you don't need such high quality products that's cheaper. 1000 dollars a ton/capacity .”*

Former Director, Research Metal Bulletin

There are several barriers to relocation

“Barriers to relocation:

- high fixed cost
- economic uncertainty
- unstable legal frame-work (e.g. in India)
- social conflicts and very high exit costs
- political pressure
- know how of the workforce (high end products) and proximity to the customers”

Former Head of Stainless Steel Division, Stemcor

Experts indicated that European steel producers can pass through a significant portion of the cost increase

- We have asked steel experts to indicate (separately for BOFs and EAFs):
 - For an X% increase in the total cost of production (where X = 5%, 10%, 15%, 20%, 25%) , what % of the additional cost would steel plants pass-through to their customers? (cost pass-through)
 - For a Y% increase in the price of steel (where Y = 5%, 10%, 15%, 20%, 25%), by what % would EU sales volumes change? (demand effect)
- We compiled the experts' responses, and have estimated the average effects. The experts' opinions are quite consistent for the cost pass through rates, but differ more widely for the demand effect; some experts provided very conservative responses (suggesting for example that a 25% increase in the EU steel price would lead to only a 12% fall in EU volumes, because of the difficulty of switching suppliers), while others were more extreme (suggesting for example that a 25% increase in price was too high, and could lead to a 35-40% drop in volumes)
- The tables below contain the average cost pass-through rates and volume changes that we use in our model

X% cost increase	5%	10%	15%	20%	25%
% of additional cost that would be passed-through for Hot rolled coil (BOFs)	57%	63%	58%	62%	60%
% of additional cost that would be passed-through for Wire rod (EAFs)	63%	67%	64%	65%	66%

Y% increase in EU price	5%	10%	15%	20%	25%
% change in EU sales volume for Hot rolled coil (BOFs)	-4%	-7%	-8%	-12%	-18%
% change in EU sales volume for Wire rod (EAFs)	-3%	-6%	-9%	-15%	-21%

- We use these responses in the following way:
 - We first estimate the increase in production cost, taking into account the change in direct and indirect carbon costs
 - We use the percentage increase in production cost to estimate the cost pass-through using the average experts' response (above), and linear interpolation
 - We then use this to estimate the increase in price, the new price, and the percentage increase in price
 - We use the percentage increase in price to estimate the change in EU sales volume from the average experts' response (above), using linear interpolation

Estimating cost pass-through and volume effects

The tables below illustrate the calculation, separately for BOFs and EAFs

Scenario (Carbon price, % auctioned)	Cost (€/tonne)	Change c.t. baseline (€/tonne)	% change c.t. baseline	% of additional cost passed through (interpolated)	Cost-pass-through (increase in price) (€/tonne)	Price (€/tonne)	% change c.t. baseline	% change in volume (interpolated)
BOFS								
Baseline	466.15					520.00		
€5, 34%	469.30	3.14	0.7%	7.6%	0.24	520.24	0.0%	0.0%
€5, 70%	472.85	6.70	1.4%	16.3%	1.09	521.09	0.2%	-0.1%
€5, 100%	475.82	9.66	2.1%	23.5%	2.27	522.27	0.4%	-0.3%
€20, 34%	479.72	13.57	2.9%	33.0%	4.48	524.48	0.9%	-0.6%
€20, 70%	493.95	27.79	6.0%	57.9%	16.11	536.11	3.1%	-2.2%
€20, 100%	505.80	39.65	8.5%	61.3%	24.32	544.32	4.7%	-3.3%
€40, 34%	493.62	27.47	5.9%	57.9%	15.89	535.89	3.1%	-2.1%
€40, 70%	522.07	55.92	12.0%	61.1%	34.18	554.18	6.6%	-4.6%
€40, 100%	545.78	79.63	17.1%	59.4%	47.30	567.30	9.1%	-6.5%
EAFs								
Baseline	464.97					525.00		
€5, 34%	462.76	-2.20	-0.5%	0.0%	0.00	525.00	0.0%	0.0%
€5, 70%	463.01	-1.96	-0.4%	0.0%	0.00	525.00	0.0%	0.0%
€5, 100%	463.21	-1.76	-0.4%	0.0%	0.00	525.00	0.0%	0.0%
€20, 34%	467.43	2.46	0.5%	6.7%	0.16	525.16	0.0%	0.0%
€20, 70%	468.39	3.42	0.7%	9.3%	0.32	525.32	0.1%	0.0%
€20, 100%	469.19	4.22	0.9%	11.5%	0.49	525.49	0.1%	-0.1%
€40, 34%	473.64	8.67	1.9%	23.6%	2.05	527.05	0.4%	-0.2%
€40, 70%	475.56	10.60	2.3%	28.9%	3.06	528.06	0.6%	-0.3%
€40, 100%	477.17	12.20	2.6%	33.2%	4.05	529.05	0.8%	-0.5%

Source: FTI Consulting analysis

Detailed modelling of the steel sector



Overview of framework

Introduction

- We have modelled the effect of removing the steel industry's carbon leakage exemptions, using a 'bottom up' cost-price model of representative steel production plants (BOF and EAF technologies separately).

Overview of the model

- Our modelling is on a 'per tonne' basis – we model the costs and revenues associated with producing and selling one tonne of steel, and then scale up the results to the EU level
- Our model considers a number of important factors, including:
 - The cost structure of plants
 - The price at which steel can be sold
 - The carbon and electricity intensity of production
 - The profit margins that can be made
 - The ability of steel producers to pass increases in their costs onto customers
 - The response of steel producers' customers to an increase in price (elasticity of demand)
- We recognise that the steel production process is complex, and that there are many different types and grades of steel. We recognise that there is a particular distinction between the
 - Two different types of plant (Basic Oxygen Furnace (BOF), and Electric Arc Furnace (EAF))
 - Two different types of steel (Flat steel, and Long steel)
- We therefore model a BOF plant producing flat steel products, and an EAF plant producing long steel products

Modelling scenarios

- We model the effect (of removing the steel industry from the carbon leakage list) by comparing a
 - A 'baseline scenario', in which the steel industry is assumed to be on the carbon leakage list, to
 - An 'ETS scenario' in which the steel industry is assumed **not** to be on the carbon leakage list
- The effect depends on the specification of the baseline and ETS scenarios

Baseline scenario

- A baseline scenario should represent the 'usual state of affairs'
- One option is to use the industry's current state (in 2012) as the baseline. However, in recent years, the industry's performance has been relatively weak. Its current level of performance (as measured by the price of steel, or the level of production, or general profitability) is not representative of the usual state of affairs
- Instead, we build a hypothetical baseline scenario, based on the prices, production levels and profitability that can be expected to persist on average during an economic cycle

ETS scenarios

- If the steel industry is removed from the carbon leakage list, it would have to purchase a % of its permits, at the market price of carbon
- We model scenarios where:
 - The price of carbon (in €/tonne of CO₂) is:
 - €5
 - €20
 - €40
 - The % of permits that must be purchased (instead of being received for free) is:
 - 34% (the EC's intended auctioning percentage in 2015)
 - 70% (the EC's intended auctioning percentage in 2020)
 - 100%
- This gives 9 scenarios

ETS scenarios	34% (of EUA permits auctioned)	70%	100%
€5 (price per tonne of CO ₂)	Scenario number 1	2	3
€20	4	5	6
€40	7	8	9

Simplified income statement for BOF and EAF plants

■ The table below shows the basic cost structure that we use for BOF and EAF plants, producing 1 tonne of steel (hot rolled coil and wire rod, respectively) – **2003-2010 average**:

(€/tonne)	BOF - HRC	EAF - WR
Price	520.00	525.00
Total cost	466.15	464.97
<i>Of which Raw materials</i>	337.15	319.97
<i>Of which Energy</i>	5.44	61.72
<i>Of which Other costs</i>	123.56	83.28
Gross profit (Price - Raw materials)	182.85	205.03
Gross margin	35%	39%
EBITDA (Price - Total cost)	53.85	60.03
EBITDA margin %	10%	11%
D&A	41.00	15.00
EBIT	12.85	45.03
EBIT margin %	2%	9%
Interest and tax	12.00	5.00
Net profit	0.85	40.03
Net margin%	0.2%	7.6%

Source: Eurostat, CEPS "Assessment of Cumulative Cost Impact for the Steel Industry", FTI Consulting interviews and analysis

Steel model: key assumptions and inputs

Baseline price, volume, and emissions assumptions

	BOF	EAF	Total
Price (€/tonne)	520	525	
Volume (million tonnes)	115.7	85.8	201.5
CO2 emissions (tonnes of CO2/tonne of steel)	1.98	0.13	

Direct and indirect cost in ETS scenarios

Scenario	BOF		EAF		Total	
	Direct carbon cost	Indirect carbon cost	Direct ETS cost	Indirect ETS cost	Direct ETS cost	Indirect ETS cost
	€ billions	€ billions	€ billions	€ billions	€ billions	€ billions
Baseline	0.00	0.04	0.00	0.32	0.00	0.36
€5, 34%	0.39	0.01	0.02	0.11	0.41	0.13
€5, 70%	0.80	0.01	0.04	0.11	0.84	0.13
€5, 100%	1.14	0.01	0.06	0.11	1.20	0.13
€20, 34%	1.54	0.05	0.08	0.46	1.62	0.51
€20, 70%	3.13	0.05	0.16	0.46	3.29	0.51
€20, 100%	4.42	0.05	0.23	0.46	4.65	0.51
€40, 34%	3.04	0.11	0.16	0.91	3.20	1.01
€40, 70%	6.10	0.10	0.32	0.91	6.42	1.01
€40, 100%	8.55	0.10	0.46	0.91	9.00	1.01

Source: Eurostat, CEPS "Assessment of Cumulative Cost Impact for the Steel Industry", FTI Consulting interviews and analysis



Modelling results

- In the following slides, we present tables and charts showing
 - The key results for the steel industry as a whole (summing together BOF and EAF plants), in the baseline and the ETS scenarios, and the difference between these scenarios
 - EBITDA
 - EBITDA margins
 - % change in EBITDA
 - Absolute change in employment
 - We then present these results separately for BOF and EAF plants

The steel industry's output, revenue, profit and employment in various scenarios

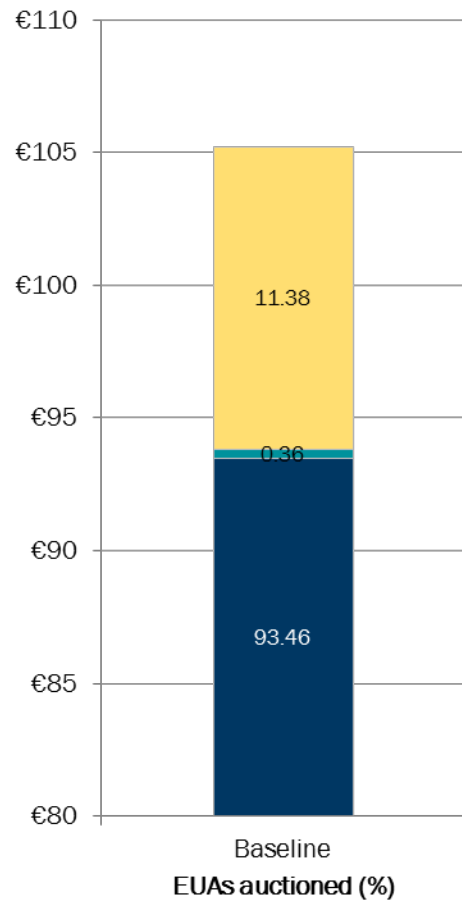
Scenario	Carbon price	% EUA auctioned	Volume	Revenue	Total cost	EBITDA	EBITDA margin	Employment estimate
	€/CO2 tonne	%	million tonnes	€ billions	€ billions	€ billions	%	Thousands of employees
0	14.2	0%	201.5	105.2	93.8	11.4	10.8%	405.3
1	5	34%	201.5	105.2	94.0	11.2	10.7%	405.2
2	5	70%	201.3	105.2	94.4	10.9	10.3%	405.0
3	5	100%	201.1	105.3	94.7	10.6	10.1%	404.6
4	20	34%	200.8	105.4	95.3	10.0	9.5%	403.9
5	20	70%	198.9	105.7	96.4	9.3	8.8%	400.2
6	20	100%	197.7	106.0	97.3	8.7	8.2%	397.6
7	40	34%	198.8	105.8	96.8	9.0	8.5%	399.9
8	40	70%	195.8	106.3	98.9	7.3	6.9%	393.9
9	40	100%	193.6	106.6	100.8	5.8	5.4%	389.5

Source: FTI Consulting analysis

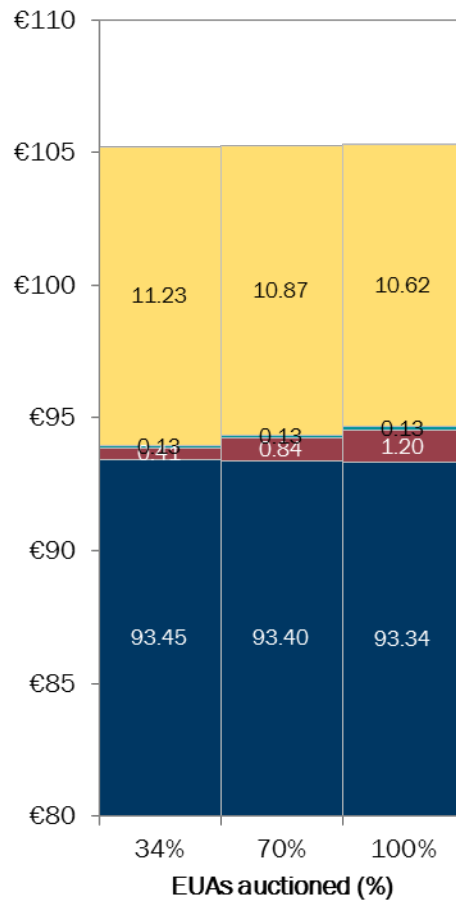
The effect of a stronger ETS on the composition of the steel industry's revenues

(€ billions)

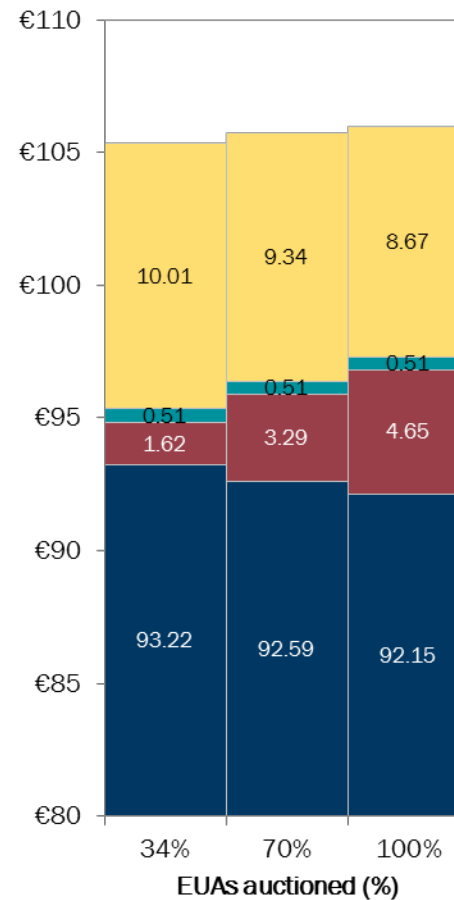
Baseline



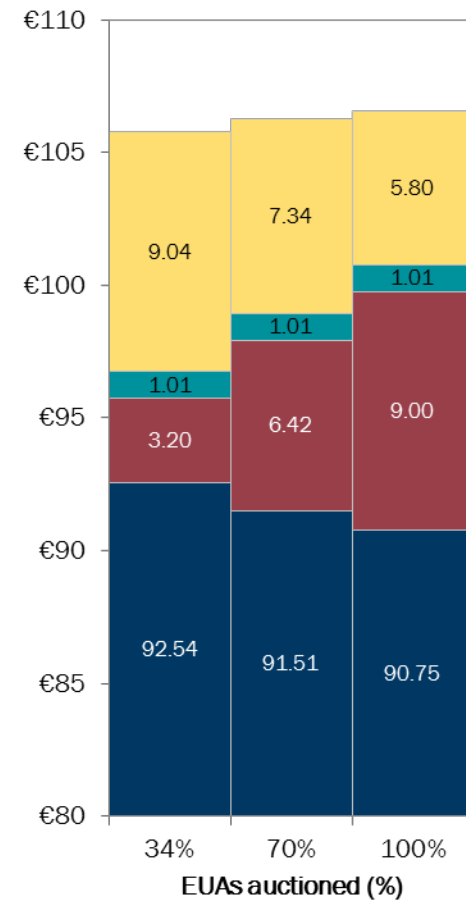
EUA price= €5.00



EUA price= €20.00



EUA price= €40.00



■ Production cost ■ Direct ETS cost
■ Indirect ETS cost ■ EBITDA

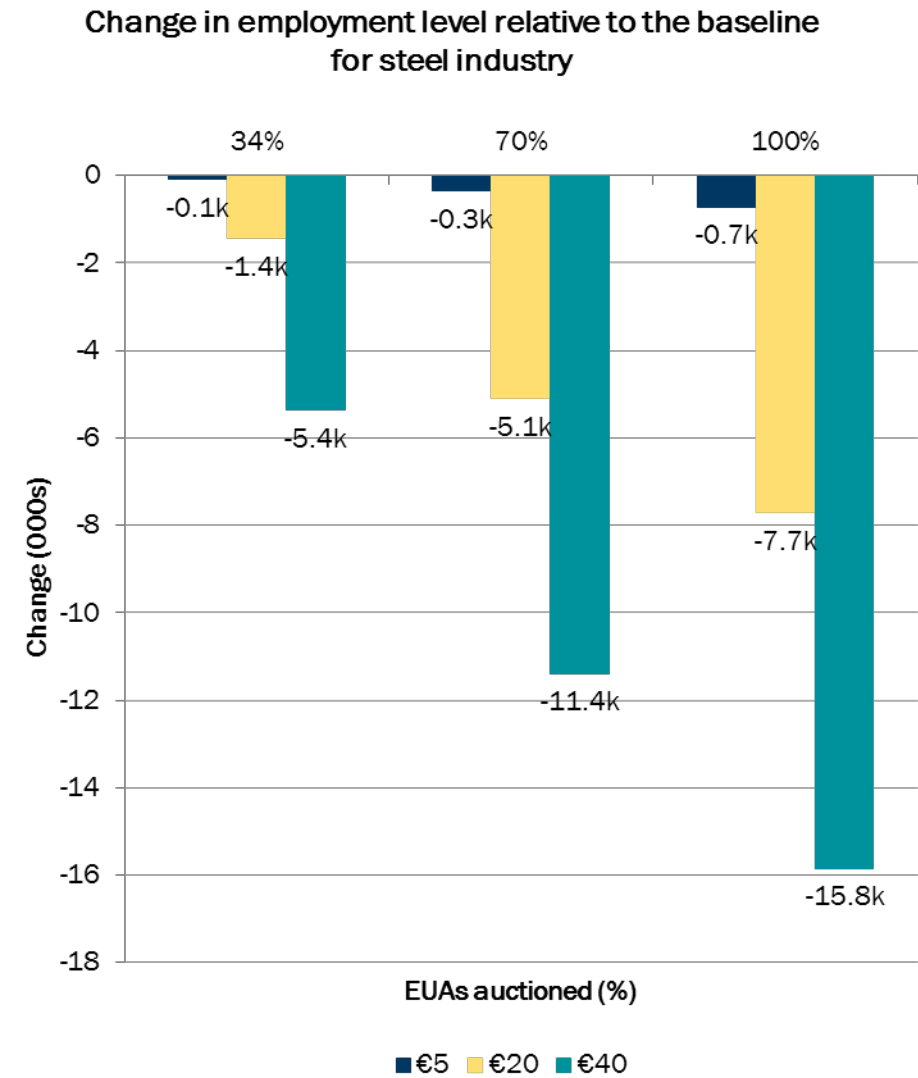
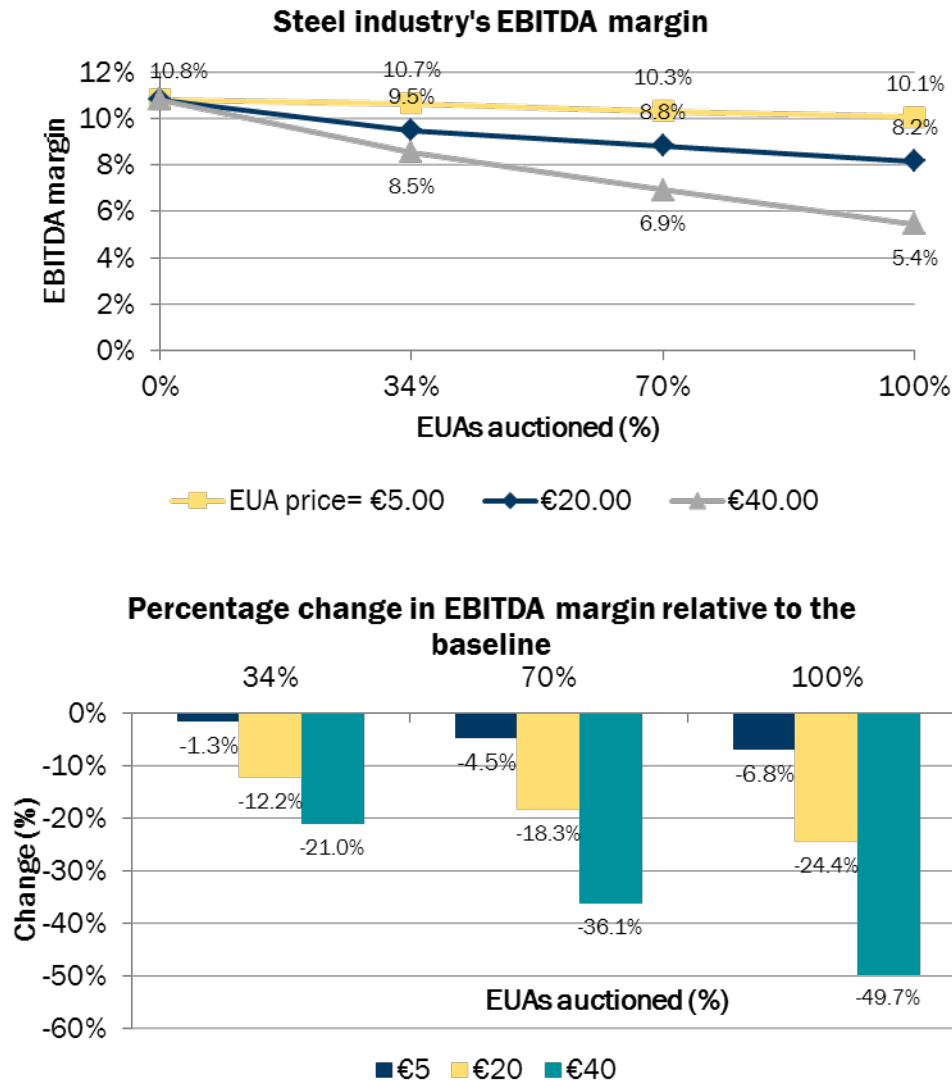
■ Production cost ■ Direct ETS cost
■ Indirect ETS cost ■ EBITDA

■ Production cost ■ Direct ETS cost
■ Indirect ETS cost ■ EBITDA

■ Production cost ■ Direct ETS cost
■ Indirect ETS cost ■ EBITDA

Source: FT Consulting analysis

The effect of a stronger ETS on the steel industry's profitability and employment



Source: FTI Consulting analysis

The steel industry's output, revenue, profit and employment in various scenarios – separately for BOF and EAF plants

BOFs

Scenario	Carbon price	% EUA auctioned	Price	Volume	Revenue	Total cost	EBITDA	EBITDA margin
	€/tonne of CO2	%	€/tonne	million tonnes	€ billions	€ billions	€ billions	%
0	14.2	0%	520.0	115.7	60.1	53.9	6.2	10.4%
1	5	34%	520.2	115.6	60.2	54.3	5.9	9.8%
2	5	70%	521.1	115.5	60.2	54.6	5.6	9.2%
3	5	100%	522.3	115.3	60.2	54.9	5.3	8.8%
4	20	34%	524.5	115.0	60.3	55.2	5.1	8.4%
5	20	70%	536.1	113.2	60.7	56.2	4.5	7.4%
6	20	100%	544.3	111.9	60.9	57.1	3.8	6.3%
7	40	34%	535.9	113.2	60.7	56.2	4.5	7.4%
8	40	70%	554.2	110.3	61.1	58.2	2.9	4.7%
9	40	100%	567.3	108.2	61.4	60.0	1.4	2.3%

EAFs

0	14.2	0%	525.0	85.8	45.1	39.9	5.2	11.4%
1	5	34%	525.0	85.8	45.1	39.7	5.3	11.9%
2	5	70%	525.0	85.8	45.1	39.7	5.3	11.8%
3	5	100%	525.0	85.8	45.1	39.8	5.3	11.8%
4	20	34%	525.2	85.8	45.1	40.1	5.0	11.0%
5	20	70%	525.3	85.8	45.1	40.2	4.9	10.8%
6	20	100%	525.5	85.8	45.1	40.3	4.8	10.7%
7	40	34%	527.0	85.6	45.1	40.6	4.6	10.1%
8	40	70%	528.1	85.5	45.2	40.7	4.5	9.9%
9	40	100%	529.1	85.4	45.2	40.8	4.4	9.7%

Source: FT Consulting analysis

The effect of a stronger ETS on BOF and EAF output, revenue, cost, and profitability

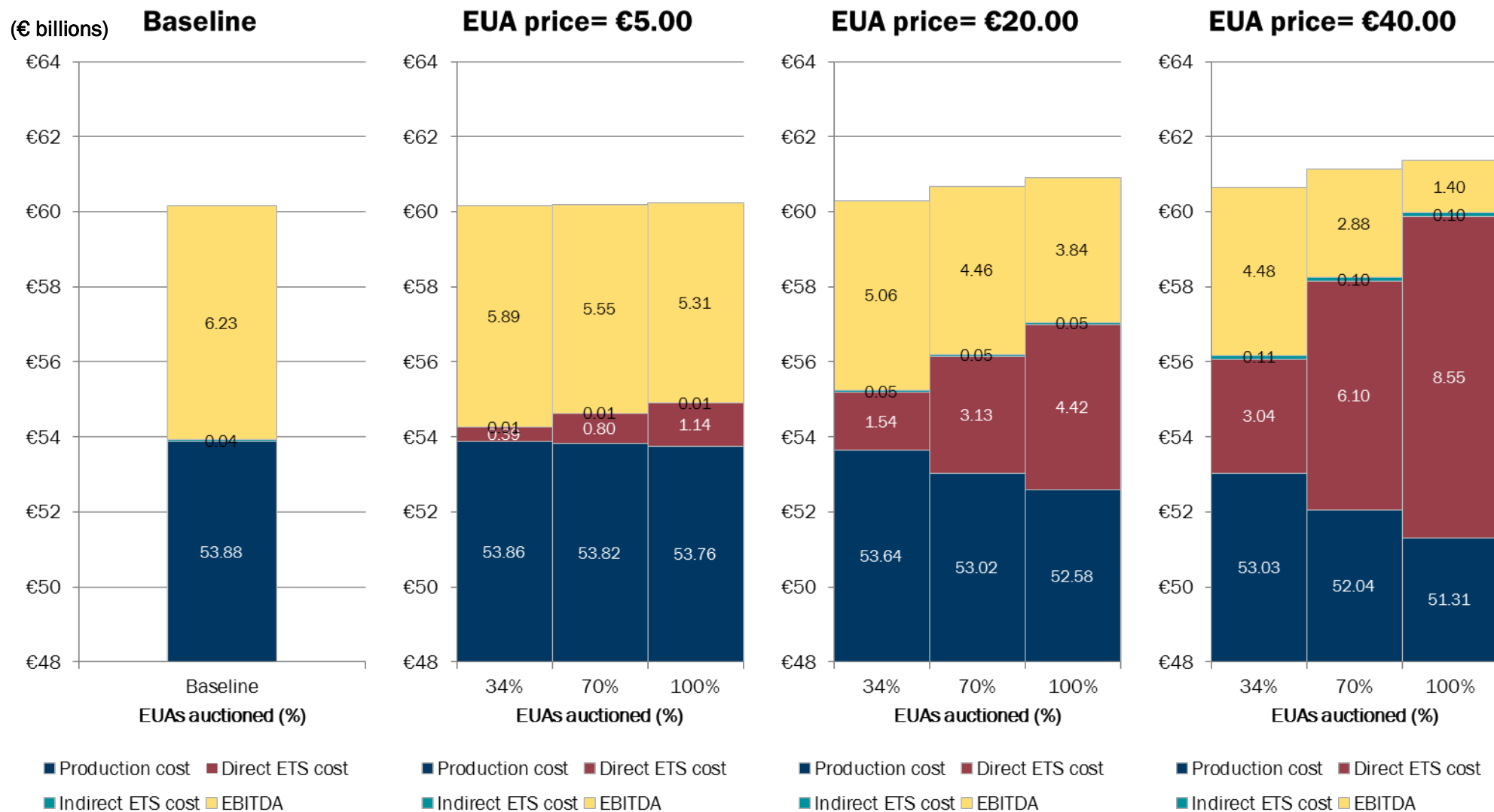
BOFs

Scenario	Carbon price	% EUA auctioned	Price	Volume	Revenue	Total cost	EBITDA	EBITDA margin
	€/tonne of CO2	%	€/tonne	million tonnes	€ billions	€ billions	€ billions	%
0	14.17	0%	0.00	0.00	0.00	0.00	0.00	0.0%
1	5.00	34%	0.24	-0.04	0.01	0.35	-0.34	-0.6%
2	5.00	70%	1.09	-0.17	0.04	0.72	-0.68	-1.1%
3	5.00	100%	2.27	-0.35	0.08	0.99	-0.92	-1.5%
4	20.00	34%	4.48	-0.70	0.15	1.32	-1.17	-2.0%
5	20.00	70%	16.11	-2.51	0.52	2.29	-1.77	-3.0%
6	20.00	100%	24.32	-3.79	0.75	3.14	-2.39	-4.0%
7	40.00	34%	15.89	-2.47	0.51	2.26	-1.75	-3.0%
8	40.00	70%	34.18	-5.37	0.98	4.33	-3.35	-5.6%
9	40.00	100%	47.30	-7.49	1.22	6.05	-4.83	-8.1%

EAFs

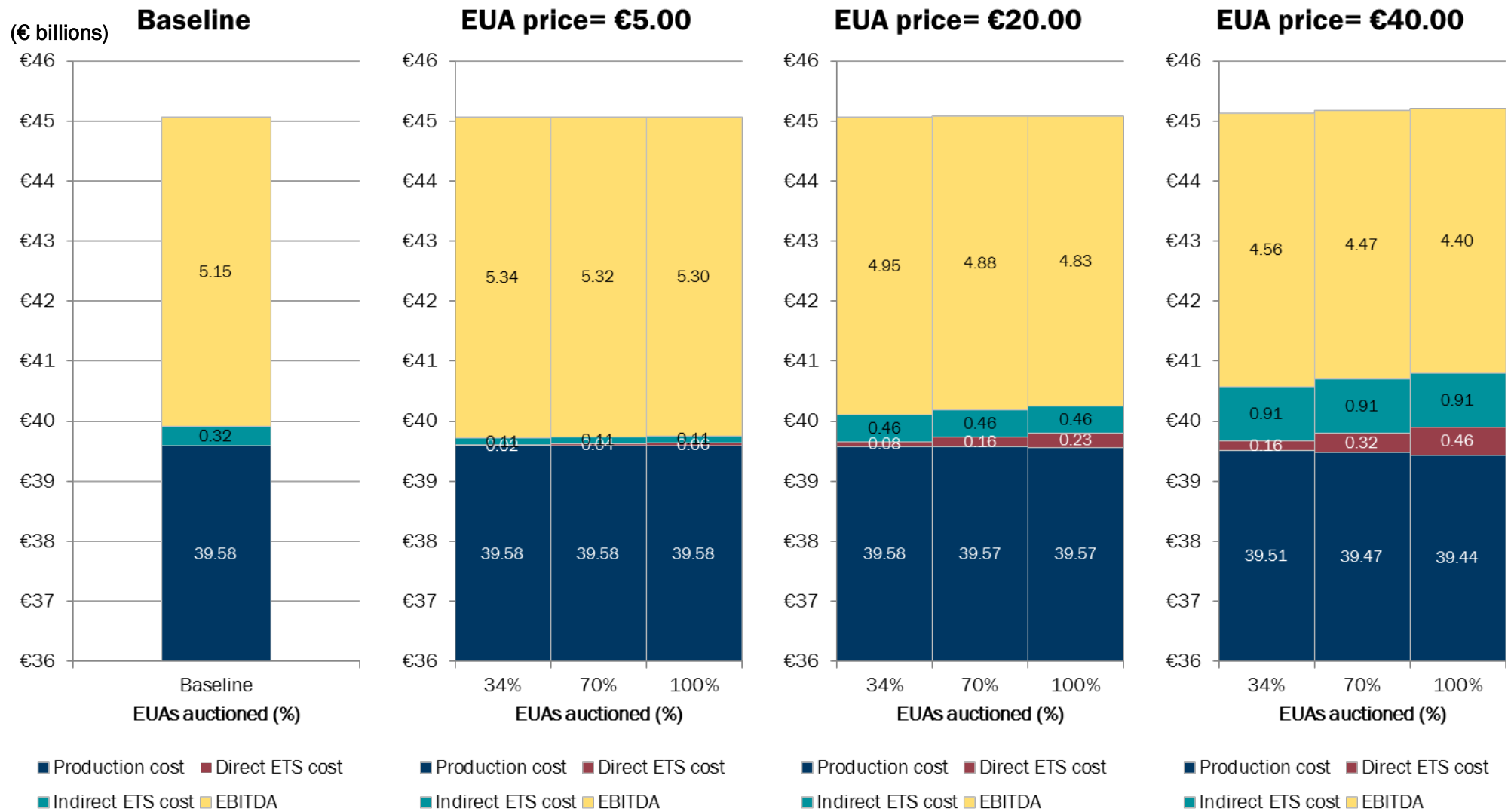
0	14.17	0%	0.00	0.00	0.00	0.00	0.00	0.0%
1	5.00	34%	0.00	0.00	0.00	-0.19	0.19	0.4%
2	5.00	70%	0.00	0.00	0.00	-0.17	0.17	0.4%
3	5.00	100%	0.00	0.00	0.00	-0.15	0.15	0.3%
4	20.00	34%	0.16	-0.02	0.01	0.20	-0.20	-0.4%
5	20.00	70%	0.32	-0.03	0.01	0.28	-0.27	-0.6%
6	20.00	100%	0.49	-0.05	0.02	0.34	-0.33	-0.7%
7	40.00	34%	2.05	-0.20	0.07	0.67	-0.60	-1.3%
8	40.00	70%	3.06	-0.29	0.11	0.79	-0.69	-1.5%
9	40.00	100%	4.05	-0.39	0.14	0.89	-0.75	-1.7%

BOFs – marked increase in direct carbon costs

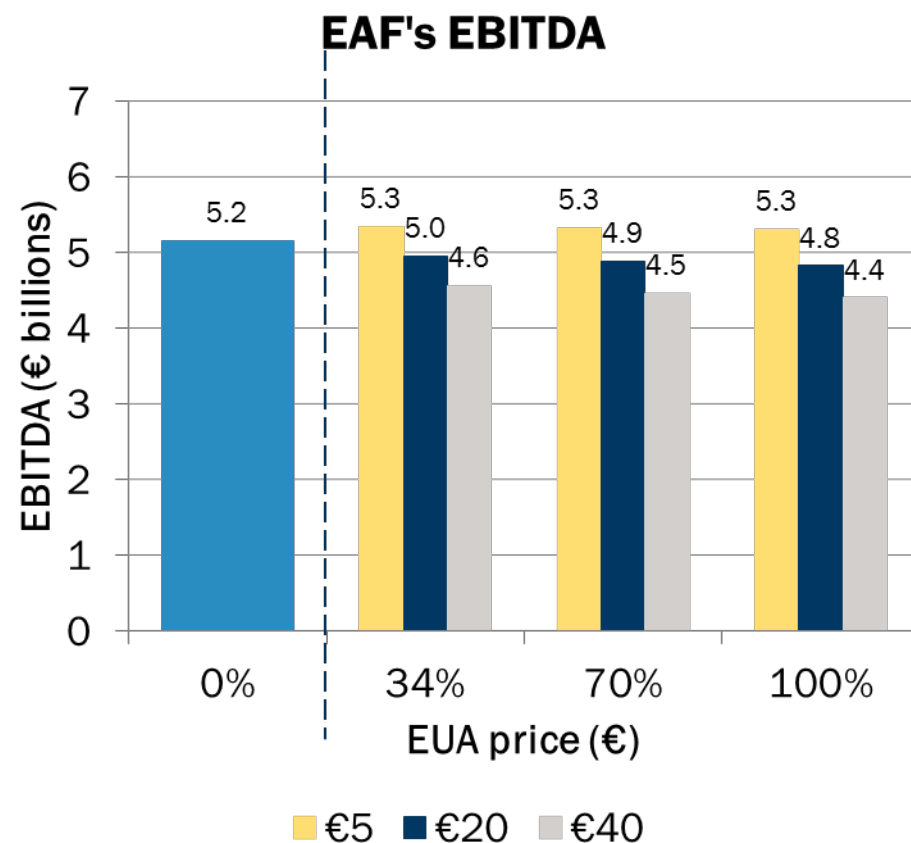
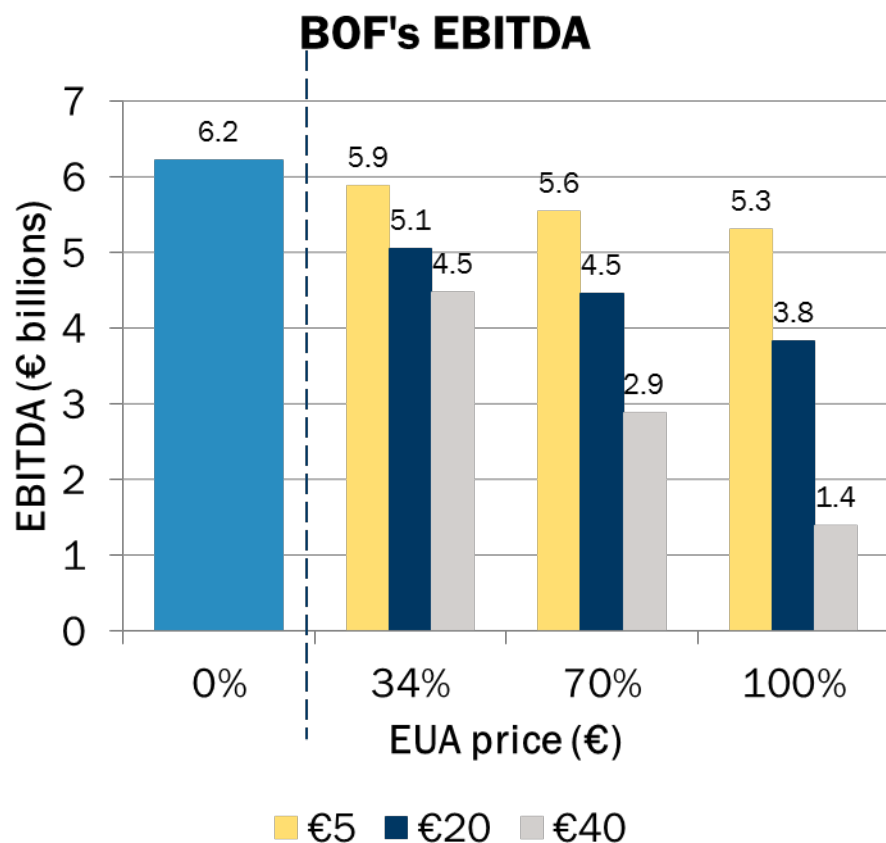


Source: FTI Consulting analysis

EAFs – carbon costs are mainly indirect



Effect on EBITDA differs by plant type (1)



BOFs' EBITDA is particularly sensitive to a stronger ETS

Source: FTI Consulting analysis

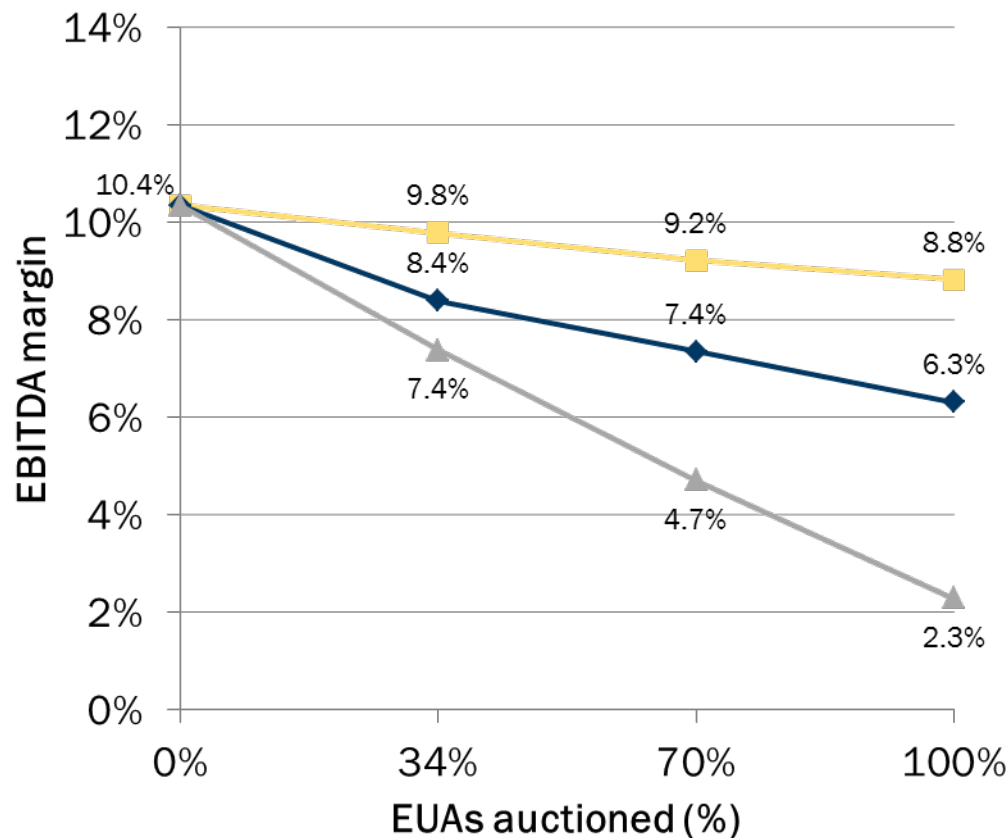
EAFs' EBITDA is less sensitive to a stronger ETS

EAFs are particularly electro-intensive

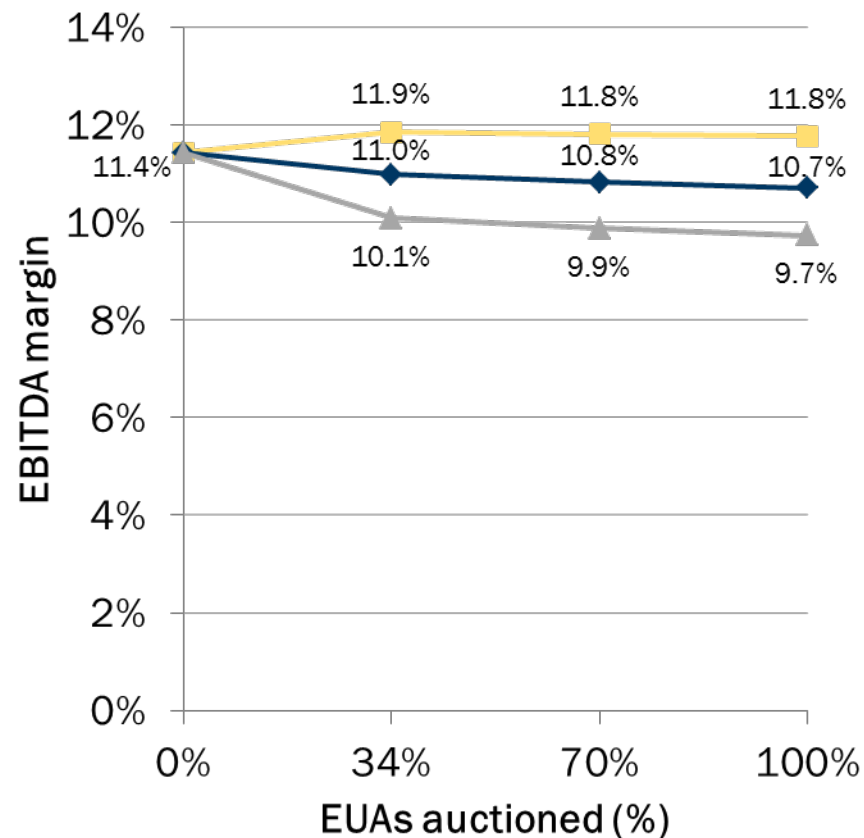
- At a carbon price of €5 (lower than the baseline carbon price of €14.20), the indirect carbon cost is reduced
- The increase in direct carbon cost is offset by this lower indirect cost, and so EBITDA is higher than in the baseline
- At a higher carbon price, EBITDA falls relative to the baseline

Effect on EBITDA differs by plant type (2)

BOF's EBITDA margin



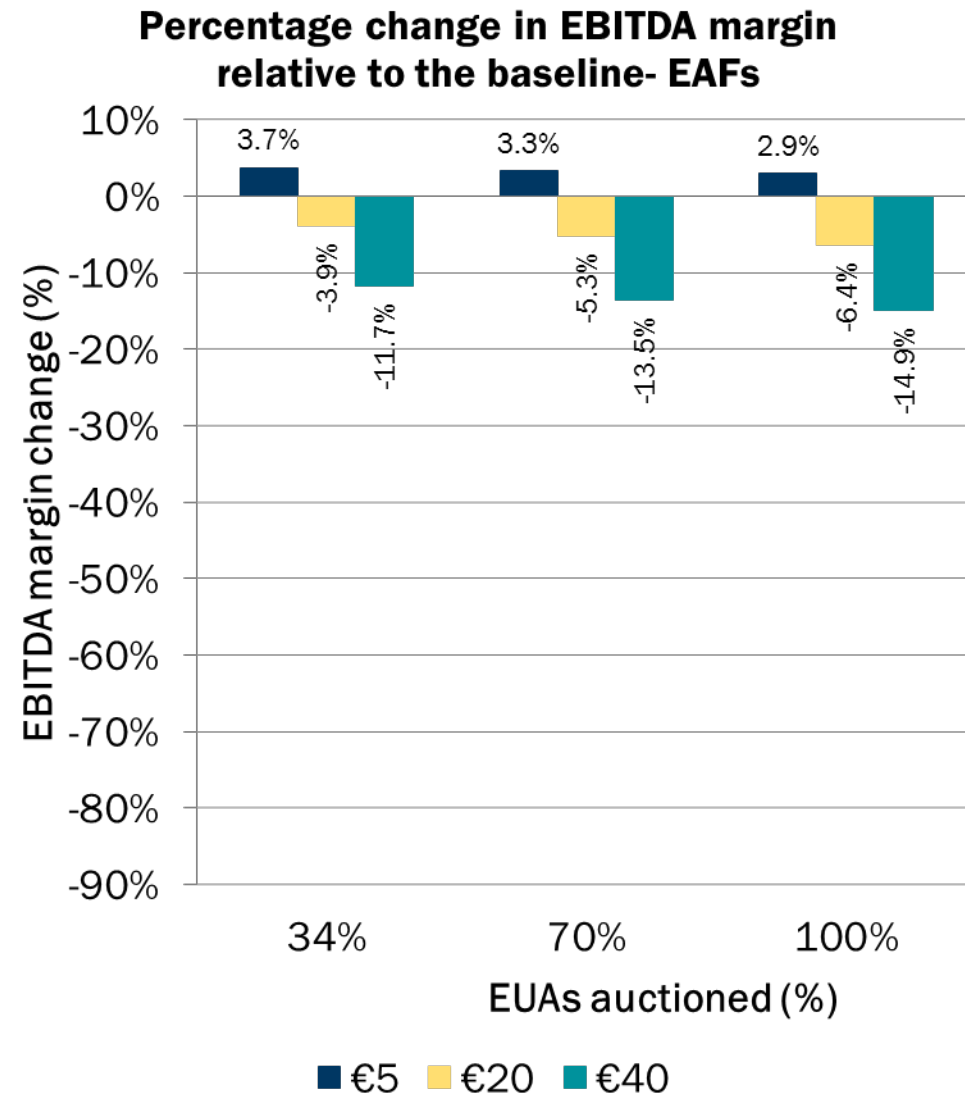
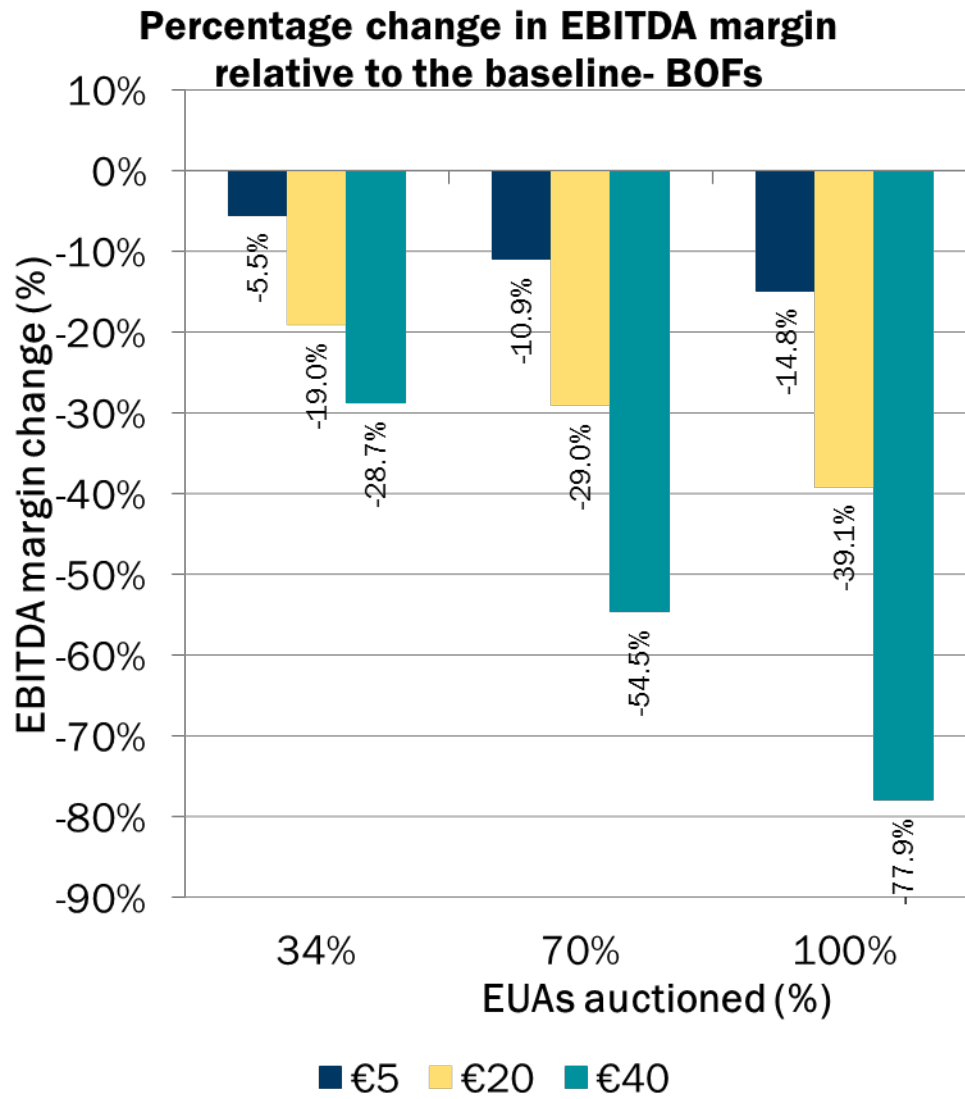
EAF's EBITDA margin



—■— EUA price= €5.00 —◆— €20.00 —▲— €40.00

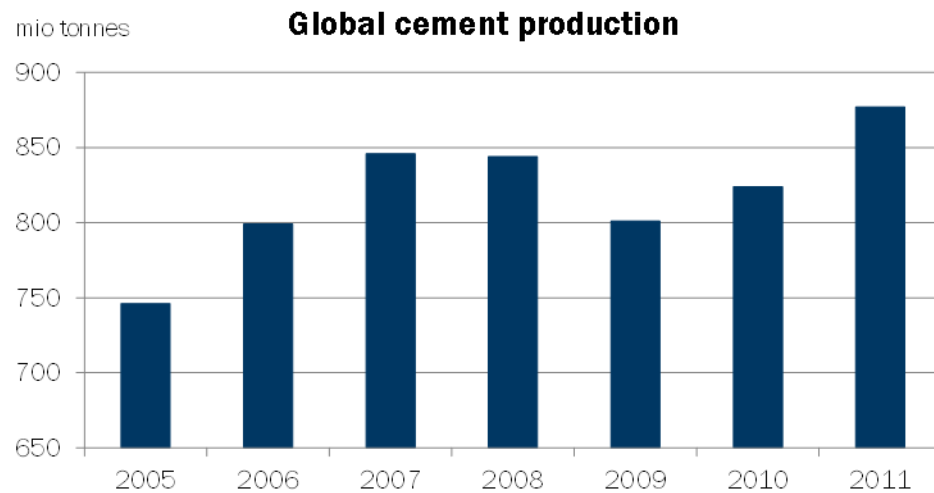
—■— EUA price= €5.00 —◆— €20.00 —▲— €40.00

Effect on EBITDA differs by plant type (3)



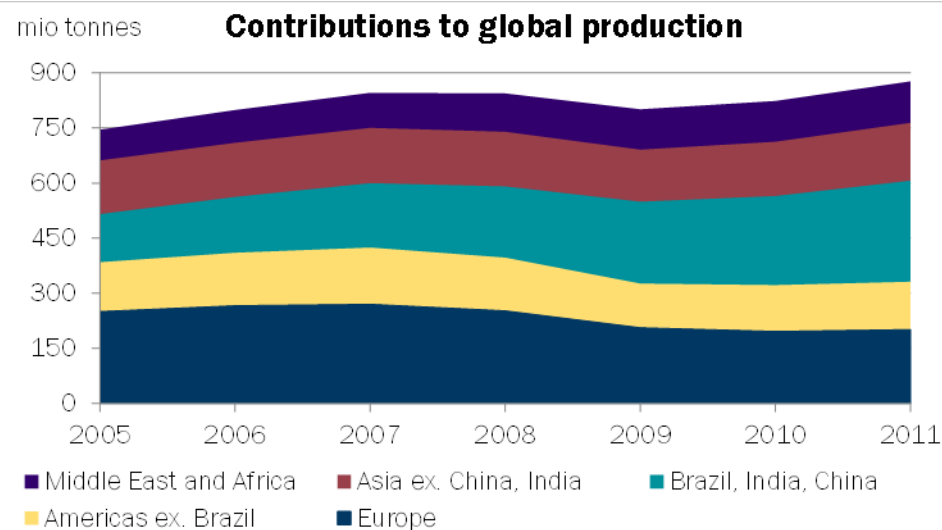
Cement sector competitiveness

Global production of cement has rebounded since the downturn



Global production rebounded after 2008

- Global cement production fell more than 5% in 2009 following the global downturn
- Since 2009 global production has been increasing. Production in 2011 surpassed the previous peak in 2007
- The relatively swift rebound in global production to some extent disguises the significant shift in its regional components

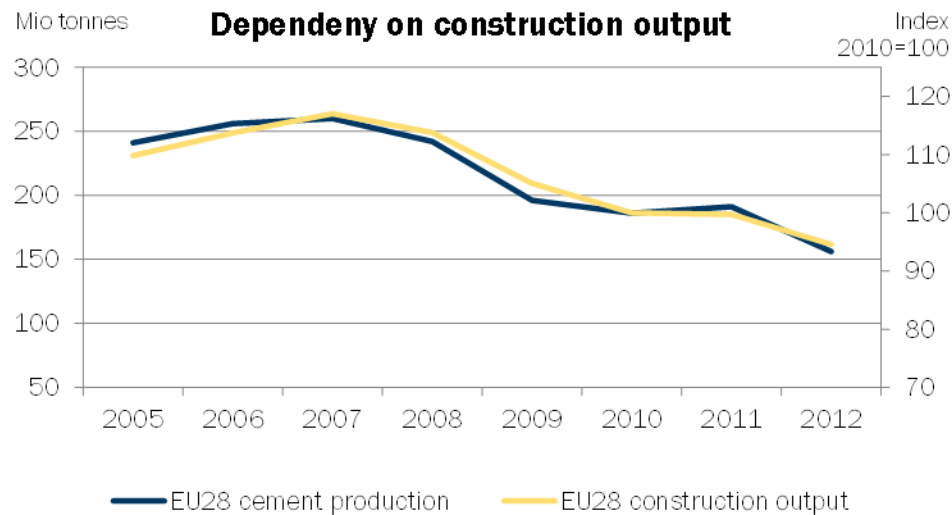


Rebound from Asia and regions of South-America

- From 2005 there has been a shift in the contribution to global production away from developed economies
- Output across developed regions such as Europe and the USA have not yet fully rebounded to pre-recession levels
- The growth in global production has been fuelled by South-America, Asia and the Middle East. In particular, Brazil, China and India doubled production between 2005 and 2011

Source: Eurostat, GNR Project 2011

EU cement production has fallen by 60% since 2007 due to weaknesses in construction activity

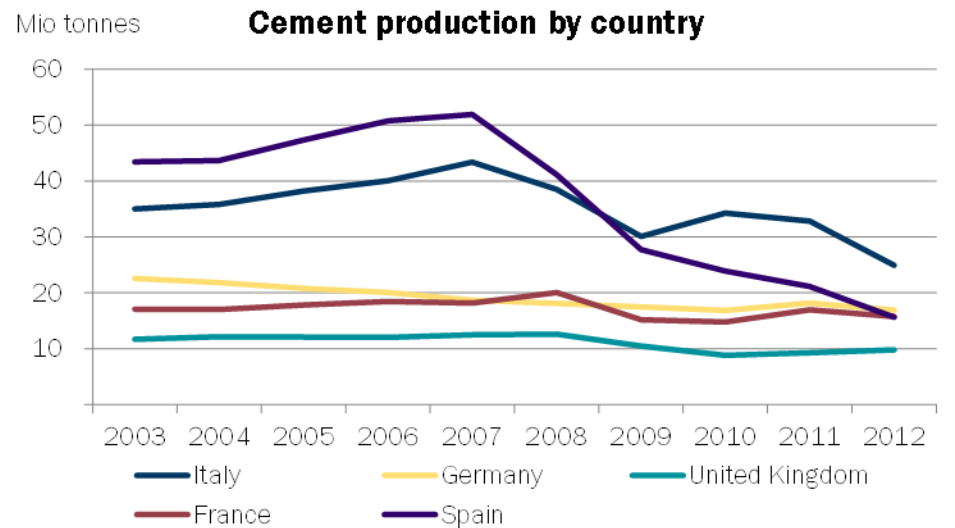


Construction dependency of cement output

- Cement is a fundamental component of the construction sector and with no alternative uses, cement producers are highly dependent on the construction sector
- The trends in construction output are mirrored with cement production. As the construction sector rebounds across Europe so too will cement production

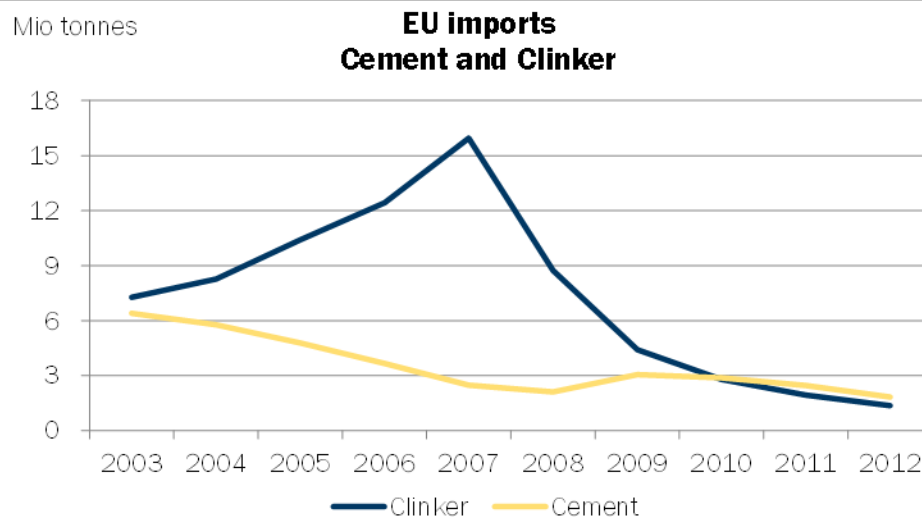
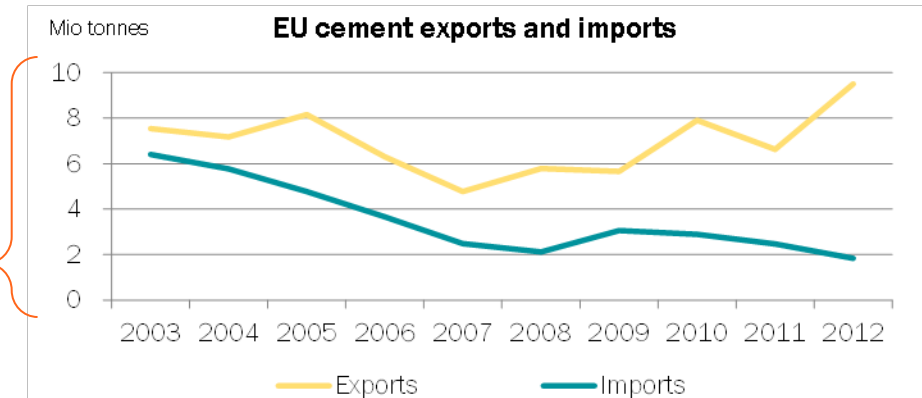
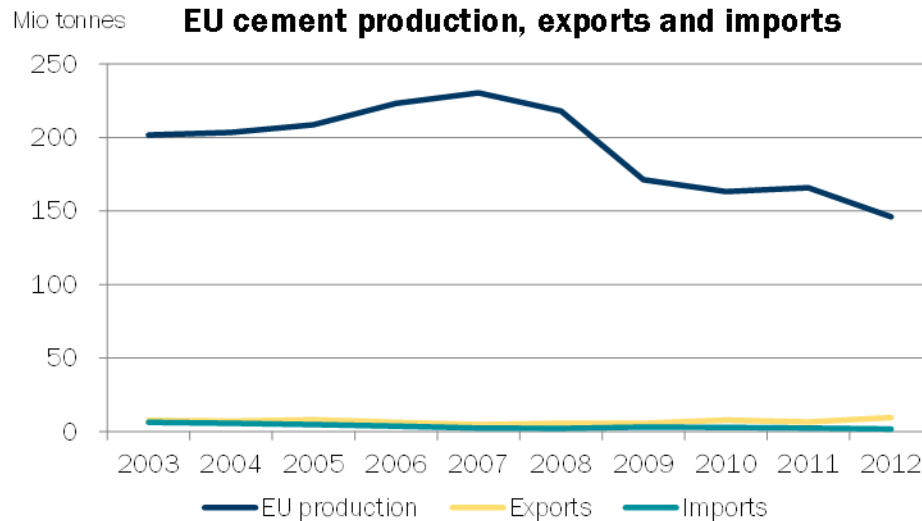
National trends in production

- The collapse of the construction sectors in Italy and Spain have resulted in cement production falling by 45% and 70%, respectively since 2007
- By comparison, the decline in domestic production in Germany, France and the UK have been significantly smaller



Source: Eurostat, GNR Project 2011

EU trade is less than 6% of production, imports have declined significantly in the wake of a weak construction sector



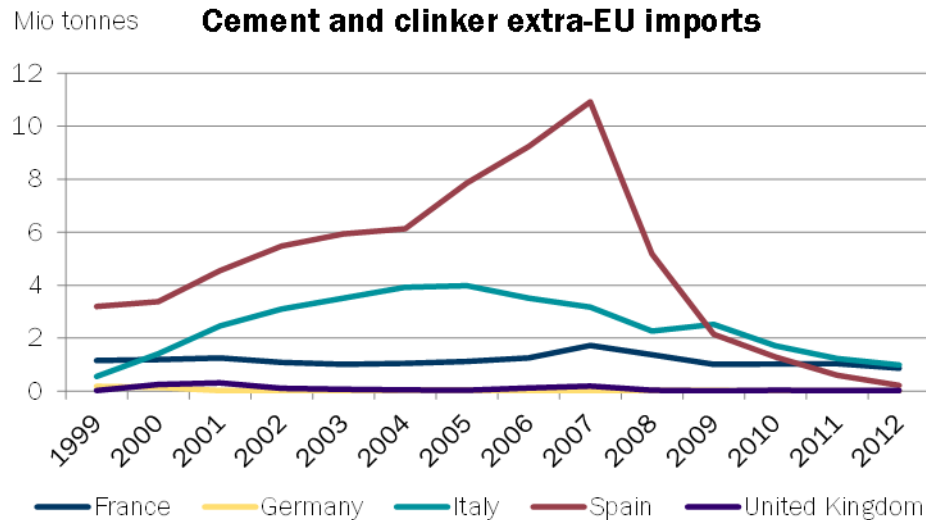
Cement is not a significantly traded product

- Cement products are not heavily traded, the average trade intensity between 2003 and 2012 is only 5.5%. Imported cement has been consistently declining and accounts for less than 2% of domestic production. This is largely due to prohibitive transportation costs
- It is more profitable to trade clinker, the main input of cement. Approximately each tonne of clinker will create 1.5 tonnes of cement. EU imports of clinker increased consistently up to 2007, and have subsequently fallen from a peak of 16 million tonnes in 2007 to 1.5 million tonnes in 2012

Source: Eurostat

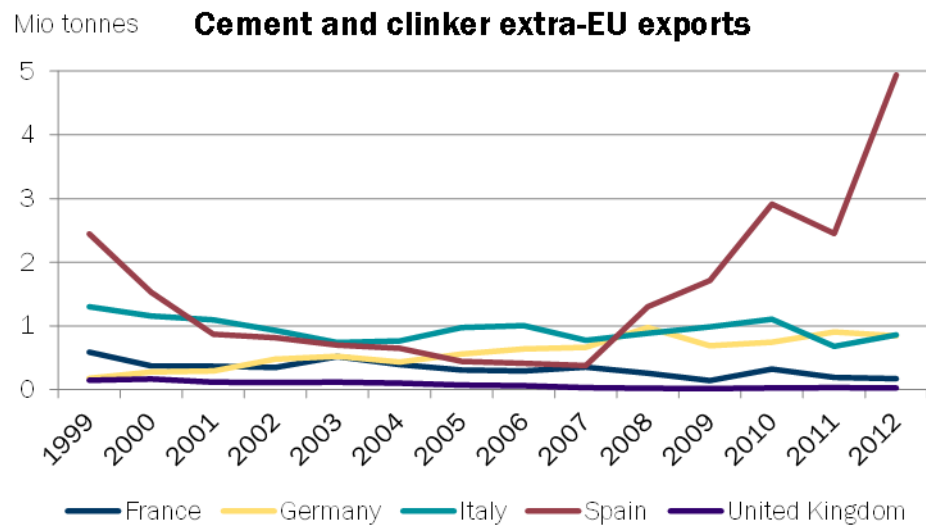
COMPASS LEXECON

There are notable differences in trade exposure across Europe; Spain and Italy account for the majority of non-EU trade



National-level differences in trade

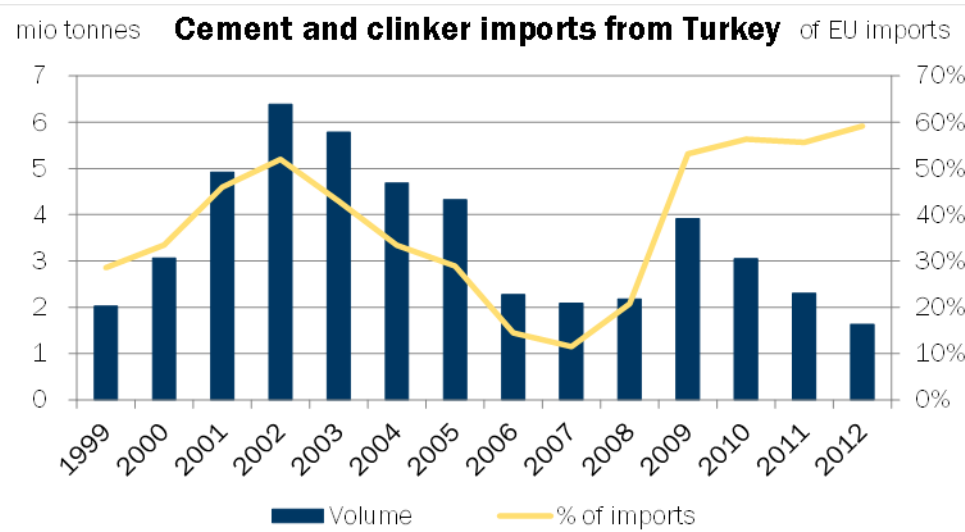
- Volumes of imported cement from outside of the EU had been significant in Spain and Italy before 2008. Significant levels of construction output throughout the late 1990's to mid-2000's caused demand to outstrip domestic supply creating the external demand. This has fallen significantly since 2008
- Imports into Germany, UK and France have always remained far lower by comparison. These are nations with sufficient domestic supply to meet demand
- Exports volumes have been consistent throughout the last decade, with the exception of Spain. Exports represent less than 5% of production for most countries
- Following the collapse of the construction sector in Spain the trend reversed and Spain became a net exporter to countries it previously had imported from



Coastal' versus 'Inland' markets

- There are European regions, such as coastal Spain and Italy, that have a historical exposure to non-EU trade links
- It would be appropriate to consider these regions with some distinction to inland markets with no direct exposure to non-EU markets and competition

Import sources and magnitudes are volatile



Long-term decline of Turkish imports, the leading importer

- Turkey is the EU's major trading partner accounting for 60% of imports in 2012. In 2007, the volume imported was some 30% higher but accounted for only 10% of EU imports
- The top 4 importers in 2007 excluding Turkey accounted for 70% of all 19 million tonnes imported
- By 2012, those 3 importers accounted for less than 10% of the 3 million tonnes imported
- Equivalently, the top 10 in 2007 imported 80% of total EU imports, which fell to just 16% by 2012

The vagaries of clinker and cement importers

		2007	2012
Total EU imports	mio tonnes	18.7	3.3
Top 4 in 2007 (ex. Turkey)	% EU imports	70%	10%
Top 10 in 2007 (ex. Turkey)	% EU imports	80%	16%

Source: Eurostat

The nature of imports has been to meet demand exceeding local domestic supply

- China imported over 9 million tonnes of cement in 2007, and only 41,000 kg in 2012
- Across the same period imported cement into Spain fell from 11million tonnes (60% of EU total) in 2007 to just 220,000 kg in 2007
- Imported cement show little sign of competition with domestic suppliers, but instead volumes are used to meet demand exceeding local supply

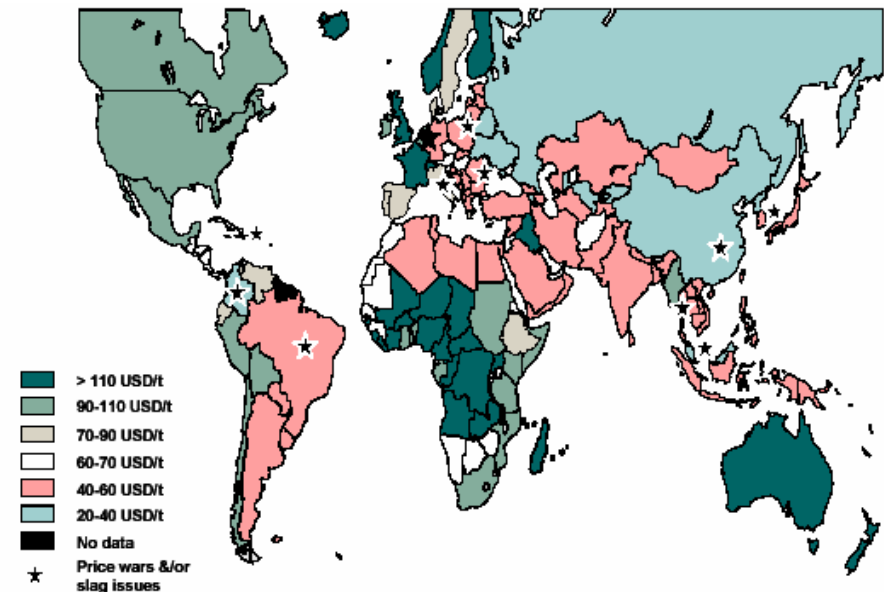
Transportation costs create regional markets; producers have pricing power

Transport costs are a major barrier to competition

- Transport costs are a restriction on the available area a single production site can supply
- The UK Competition Commission determined the maximum geographic area over which cement can be transported is **up to 100 miles** (UK Competition Commission 2013)
- In Europe, the average cost of transporting, by road, one tonne of material for one kilometre is in the region of €0.07. (CE Delft 2010)
- The road transportation cost of one tonne of cement is therefore €11.30, or equivalent to 16% of expected revenue. The geographical restrictions on competition reinforce regional markets
- Additional shipping cost for non-EU competitors shelter much of the European area from non-EU competition, before even considerations for product
- The significant regional differences in price levels globally reveal the lack of effective competitive pressure on any regional cement prices

Description/ Source	Value
Relevant geographic area (UK CC 2013)	100 miles /161 km
EU average road transport cost (CE Delft 2010)	€0.07
Road transport costs - 100 miles per tonne of cement	€11.30
EU average revenue per cement tonne (Eurostat 2012)	€73
Road transport costs – proportion of average revenue	16%

2006 Global cement prices



Source: Exane BNP Paribas estimates

Market power of EU cement producers is confirmed by several cartel cases ...

European Commission (2008)

“Market concentration in the cement industry is rather high and prone to collusion and formation of cartels”.

- “The cement sector is unlikely to be significantly exposed to international competition due to high transportation costs”.

(EC code 52008SC0052)

European Commission (2008)

“Due to the need of significant capital requirements, energy intensive industries tend to operate in fairly concentrated markets. Some of these industries have a significant track record of collusion and infringements of the competition rules. **If companies prove to be able to increase prices by collusion, they can not be expected to have great difficulties in increasing prices to a similar extent when facing increased cost of emissions**”. (EC code 52008SC0052)

UK Competition Commission 2013

“The CC has provisionally concluded that coordination between the three major cement producers (Lafarge Tarmac, Cemex and Hanson) in the cement market is likely to be resulting in higher prices for all cement users.”

(Aggregates, cement and ready-mix concrete market investigation)

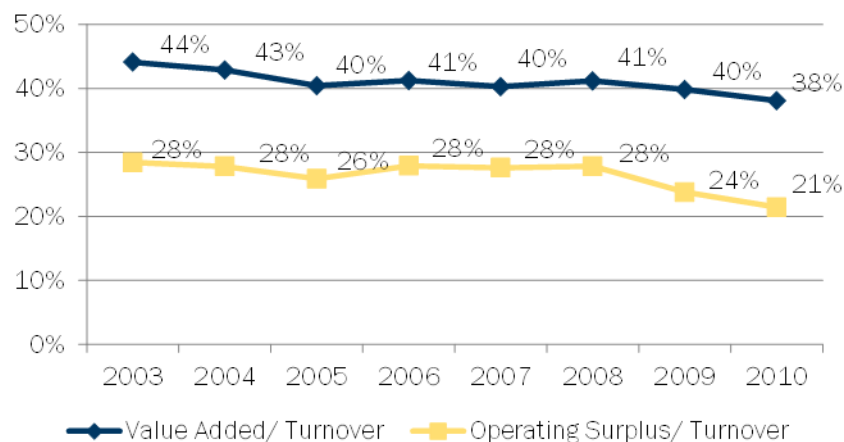
European Commission (1994)

European Commission fines cement cartels €13.5m Euro¹ and concludes “Anti-competitive practices and agreements constitute economic infringements designed to maximise the profits of the participating undertakings. The harmful effects for the markets and for consumers are particularly serious in the cement sector, since they are passed on to the construction and housing sector and to the real-estate market in general”. (European Commission).

¹(Note – fine level later changed)

... as well as by high margins

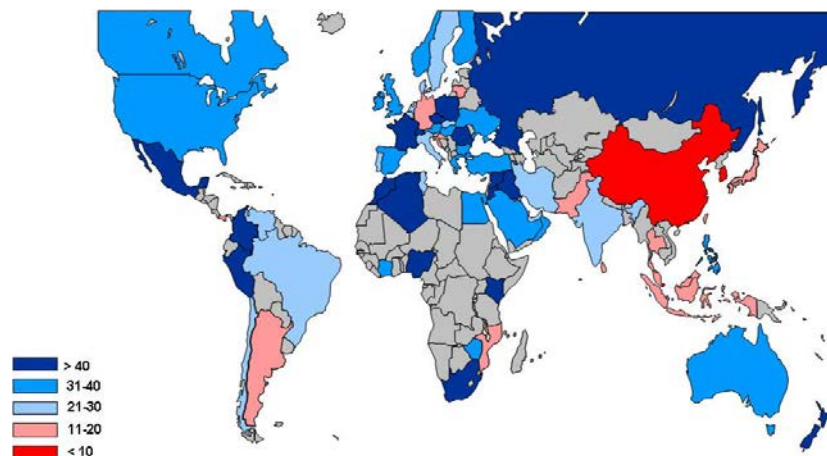
Cement industry margins - EU



Operating margins decline across EU since 2008

- Pre-2008 profit margins were robust across Europe. This was followed by a sequence of anti-trust investigations. Margins are pro-cyclical and follow closely the performance of the construction sector
- Firms require good long-run operating profit margins to return significant investment in capital equipment
- Decline in construction output across Europe has eroded margins throughout this period. Margins are expected to rebound with construction sector output

EBITDA per tonne cement (US\$/t) 2007



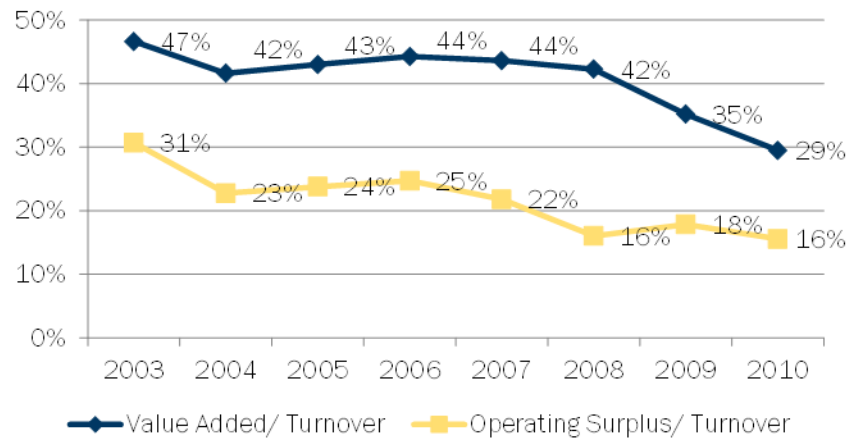
EBITDA levels in Europe among the highest globally

- Pre-2008 unit EBITDA across European markets were generally among the highest globally in 2007. They are typically between \$31-\$40/ €23- €29 per tonne, in some regions sustained beyond \$40/ €29 per tonne

Source: Eurostat, Exane BNP Paribas

High margins confirm pricing power of cement producers

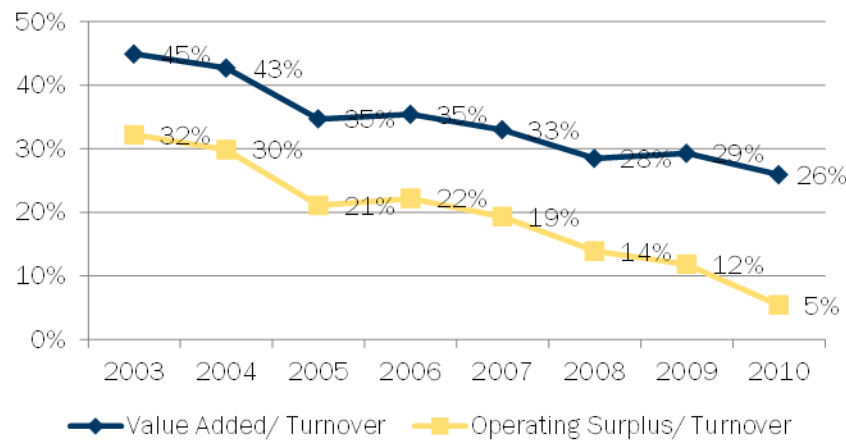
Cement industry margins - UK



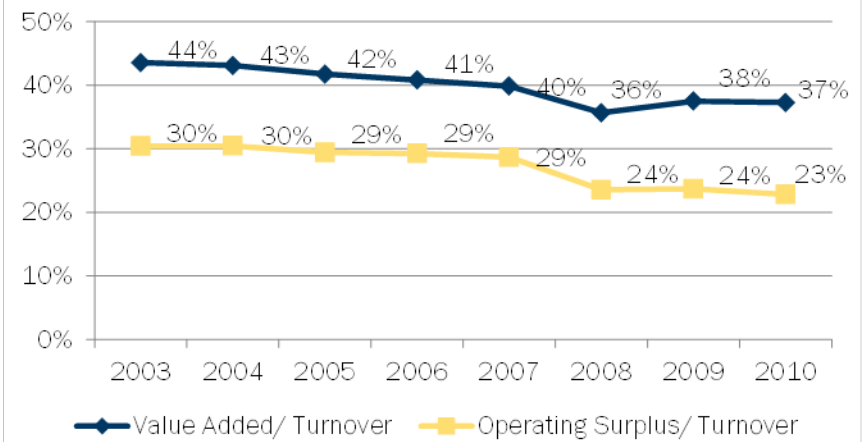
Profit margins affected asymmetrically across EU

- Within Europe, regional trends in construction and demand for cement have caused regional differences in the ability to sustain profit margins
- Imports are a small and declining proportion of the market. Therefore the decline in margins is due to demand weakness of these markets and not a result of import competition
- There is scope to rebuild margins as the construction sector output returns to normal levels

Cement industry margins - Italy



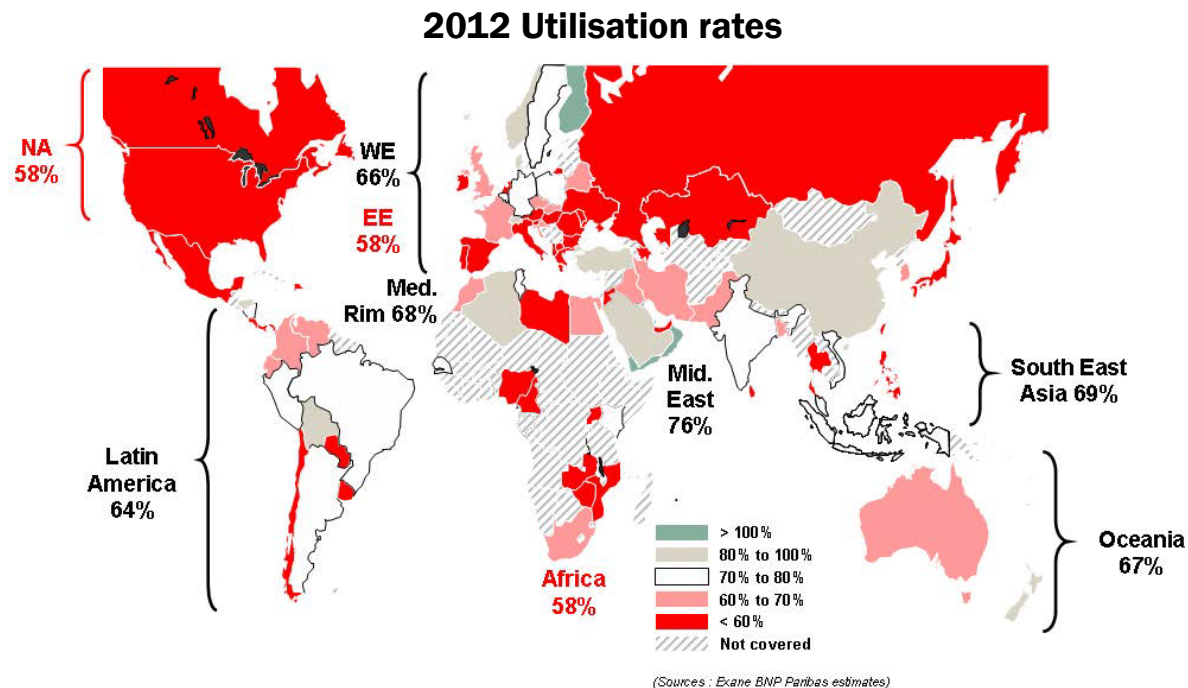
Cement industry margins - France



Major spare capacity remains across economically developed regions, developing regions operating with lower capacity

Lower spare capacity developing regions give little import threat to high spare capacity regions across Europe and North America

- Developed regions continue to have significant spare production capacity
- Developing regions are operating at higher capacity rates backed by stronger local demand
- Cembureau estimates the cost of a new plant equipped with the latest preheater and precalciner technology with a production capacity of 1mn tonnes per year in the region of € 150mn . Other sources equate the cost of a new plant to broadly 3 years of revenue



Source: Exane BNP Paribas 2012

Emissions are generated in the production of clinker, the proportion of clinker determines the cement grade

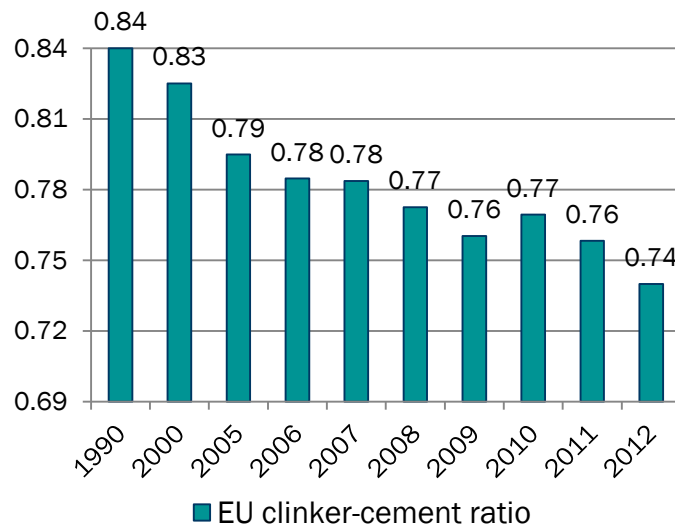
Portland cement grades	% Clinker	Emissions range CO ₂ / tonne
CEM I	95%	800 kg
CEM II	65% - 95%	545 – 800 kg
CEM III	5% - 65%	45 – 545 kg
CEM IV	45% - 90%	380 – 755 kg
CEM V	20% - 65%	170 – 545 kg

Proportion of clinker varies by cement grade

- Portland cement is the most produced form of cement used across construction projects. The different grades are characterised by the proportion of clinker and the composition of other materials
- The higher grades are with larger proportions of clinker and better cementitious qualities. However, in the last decade significant improvements have been made to the quality of lower grades
- The vast majority of production emissions are generated through clinker production. Specifically,
 - the chemical reaction to convert limestone to quicklime (~67%), and
 - the energy to generate kiln temperatures and to operate machinery (~33%)

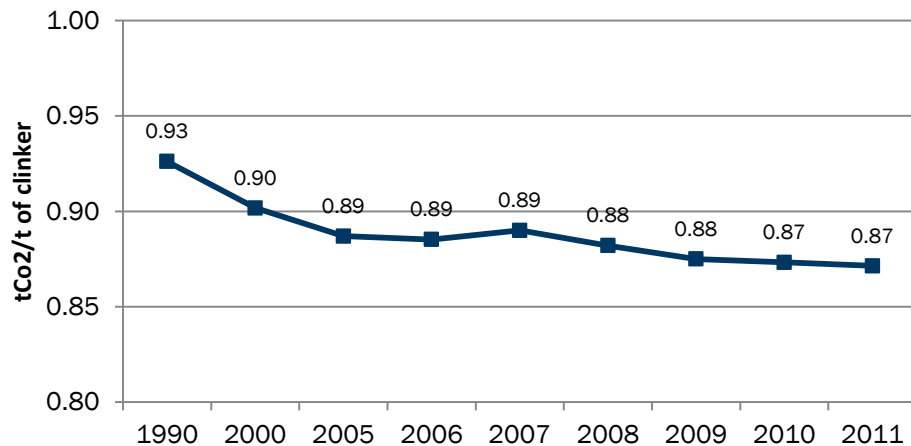
Overall clinker volume in cement steadily declining for two decades

- The clinker-cement ratio has the most influence on average emissions per tonne of cement produced. The average clinker-cement ratio has consistently fallen across Europe since 1990, partly due to improvements in lower cement grade quality. Approximately 60% of cement produced is CEM II, 25% is CEM I
- Current EU average clinker-cement ratio is 0.74 or ~620 kg CO₂ / average cement tonne



Emissions efficiency gains since 1990's have stagnated through the 2000's

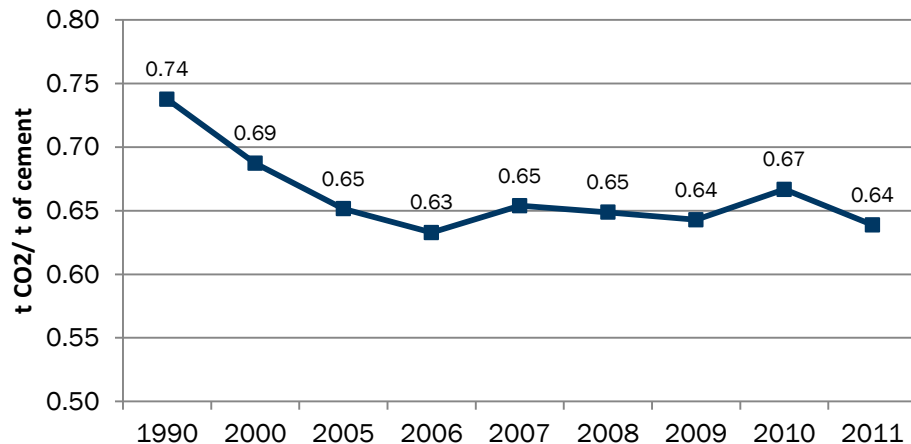
Emissions of carbon dioxide in clinker production



EU clinker emission abatement has slowed significantly since 2000

- There was a marked decline in CO₂ emissions per tonne of clinker produced, with a 4 percentage point fall between 1990 and 2006
- In recent years, emissions have remained broadly constant
- Incentivising the application of optimal abatement technologies throughout the EU cement sector will reinforce emissions abatement

Emissions of carbon dioxide in cement production



Significant individual plant abatement characteristics

- Cement kilns are able to utilise a wide variety of fuel types. From traditional fossil fuels including Coal and Petcoke to alternative fuels such as timber and other biomass and also waste products
- The proportion of non-traditional fuel has increased across the world, current averages are around 17% of total fuel consumption. However, there are significant individual plant differences, with availability and consistency of supply a main restriction
- Improvements in waste and biomass collection and transportation infrastructure enable greater use of non-traditional fuel

Academic literature provides a range of estimates for price elasticity and the cost pass-through rates

Price elasticity of demand

- Cement is a key material with very few substitutes, the construction industry is highly pro-cyclical and cement costs represent a minor proportion of final product costs. Therefore, the effect on market demand following a change in prices is likely to be relatively small
- These estimates have informed the consideration of the relevant price elasticity in our cement sector model

Cost pass-through rates

- A wide variation of estimates for cost pass through rates exists in the literature. The variation is both as a result of different approaches and data quality
- This variation is also likely to be the result of the many different regional markets each with their own characteristics and degree of competitive forces

Academic literature estimates – price elasticity

Source	Price elasticity of demand
LaCour and Mollgard (2002)	-0.27
Oxera (2004) and Ponssard & Walker (2008)	-0.40
Demailly and Quirion (2005)	-0.20

Academic literature estimates – cost pass-through rates

Source	Cost pass-through rate
Oxera (2004)	80% (UK)
Ponssard (2009)	64% average, 55% : 75% (Inland : Coastal)
Walker <i>et al</i> (2007)	10% (Italy), 30% (Germany, UK)

“Organizing production elsewhere, creating capacity solely to serve Europe is logistically very difficult. Plus there is a whole bunch of risks, transport, exchange rates, storage, physically moving the products, port capacity etc.”

Cement experts interviewed by CDC Climate

Detailed modelling of the cement sector



Modelling results

- In the following slides, we present tables and charts showing
 - The key inputs and assumptions
 - The key results for the cement industry as a whole (summing together coastal and inland plants), in the baseline and the ETS scenarios, and the difference between these scenarios
 - EBITDA
 - EBITDA margins
 - % change in EBITDA
 - Absolute change in employment
 - We then present these results separately for coastal and inland plants

Cement model: Key assumptions and inputs

Baseline market and emissions assumptions

	Inland	Coastal	Total
Price (€/tonne)	78	70	
Volume (million tonnes)	90	135	225
CO2 emissions (tonnes of CO2/tonne of cement)	0.57	0.57	0.57
Cost pass through rate (% of additional cost)	80%	40%	
Price elasticity of demand	-0.3	-0.3	

Direct and indirect cost in ETS scenarios

Scenario	Inland		Coastal		Total	
	Direct carbon cost	Indirect carbon cost	Direct ETS cost	Indirect ETS cost	Direct ETS cost	Indirect ETS cost
	€ billions	€ billions	€ billions	€ billions	€ billions	€ billions
Baseline	0.00	0.04	0.00	0.06	0.00	0.10
€5, 34%	0.06	0.01	0.09	0.02	0.15	0.04
€5, 70%	0.12	0.01	0.19	0.02	0.31	0.03
€5, 100%	0.18	0.01	0.27	0.02	0.44	0.03
€20, 34%	0.24	0.06	0.36	0.08	0.60	0.14
€20, 70%	0.49	0.05	0.73	0.08	1.22	0.14
€20, 100%	0.69	0.05	1.03	0.08	1.72	0.14
€40, 34%	0.47	0.11	0.71	0.16	1.18	0.27
€40, 70%	0.95	0.11	1.42	0.16	2.37	0.27
€40, 100%	1.32	0.10	1.98	0.16	3.30	0.26

The cement industry's output, revenue, profit and employment in various scenarios

Scenario	Carbon price	% EUA auctioned	Volume	Revenue	Total cost	EBITDA	EBITDA margin	Employment estimate
	€/CO2 tonne	%	million tonnes	€ billions	€ billions	€ billions	%	Thousands of employees
0	14.2	0%	224.1	16.4	11.6	4.8	29%	62.2
1	5	34%	223.7	16.5	11.8	4.7	29%	62.1
2	5	70%	223.0	16.5	12.0	4.6	28%	61.9
3	5	100%	222.4	16.6	12.2	4.4	27%	61.7
4	20	34%	221.2	16.7	12.5	4.2	25%	61.4
5	20	70%	218.4	17.0	13.3	3.7	22%	60.6
6	20	100%	216.0	17.2	14.0	3.3	19%	59.9
7	40	34%	217.9	17.1	13.4	3.6	21%	60.4
8	40	70%	212.2	17.6	15.0	2.6	15%	58.9
9	40	100%	207.5	18.0	16.2	1.8	10%	57.5

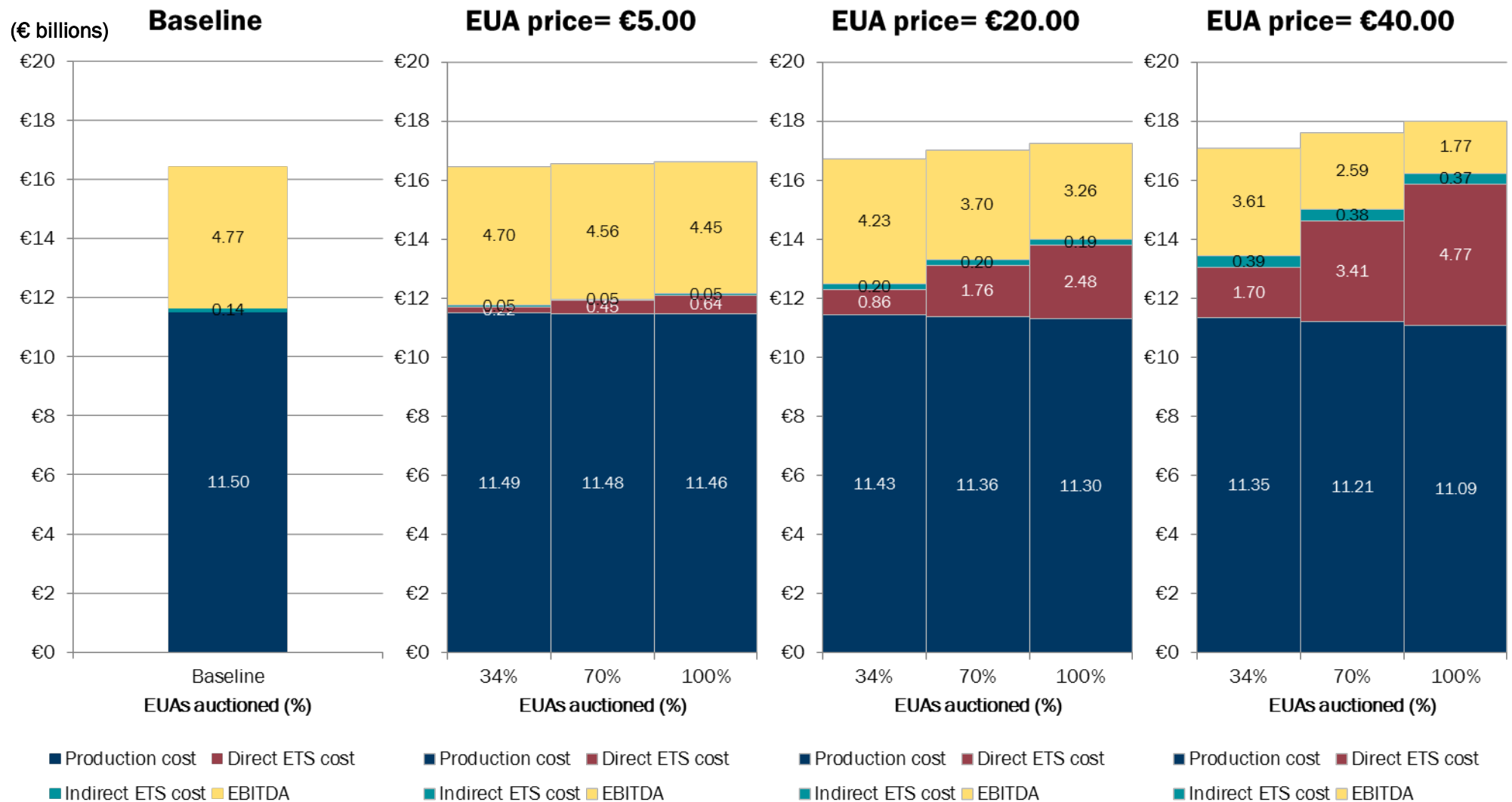
Source: FTI Consulting analysis

The effect of a stronger ETS on the cement industry's output, revenue, profit and employment in various scenarios

Scenario	Carbon price	% EUA auctioned	Volume	Revenue	Total cost	EBITDA	EBITDA margin	Employment estimate
	€/CO2 tonne	%	million tonnes	€ billions	€ billions	€ billions	%	Thousands of employees
0	14.2	0%	0.0	0.0	0.0	0.0	0%	0.0
1	5	34%	-0.4	0.0	0.1	-0.1	-1%	-0.1
2	5	70%	-1.1	0.1	0.3	-0.2	-1%	-0.3
3	5	100%	-1.7	0.2	0.5	-0.3	-2%	-0.5
4	20	34%	-2.9	0.3	0.8	-0.5	-4%	-0.8
5	20	70%	-5.7	0.6	1.7	-1.1	-7%	-1.6
6	20	100%	-8.1	0.8	2.3	-1.5	-10%	-2.3
7	40	34%	-6.2	0.6	1.8	-1.2	-8%	-1.7
8	40	70%	-11.9	1.2	3.4	-2.2	-14%	-3.3
9	40	100%	-16.7	1.6	4.6	-3.0	-19%	-4.6

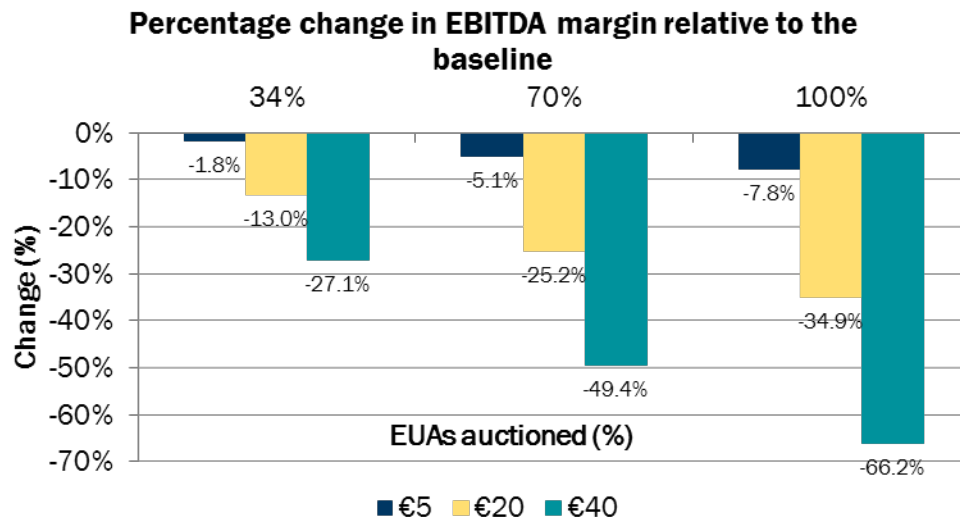
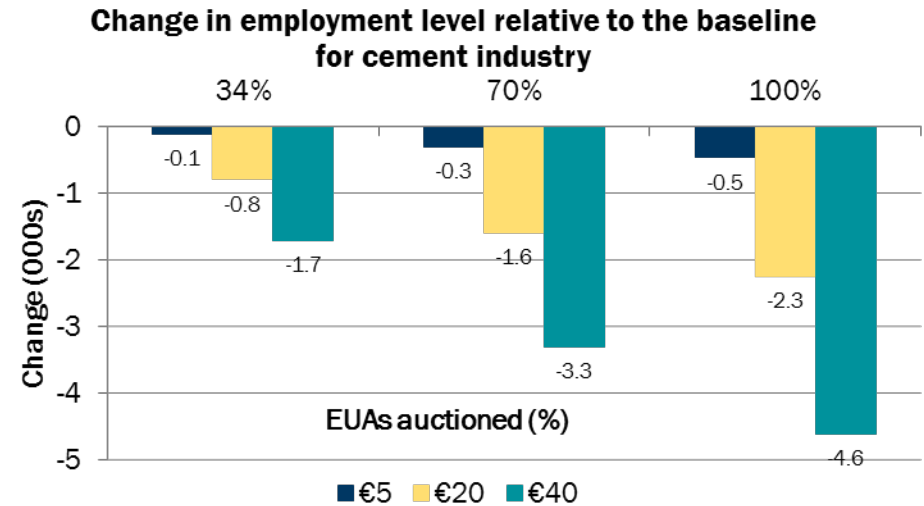
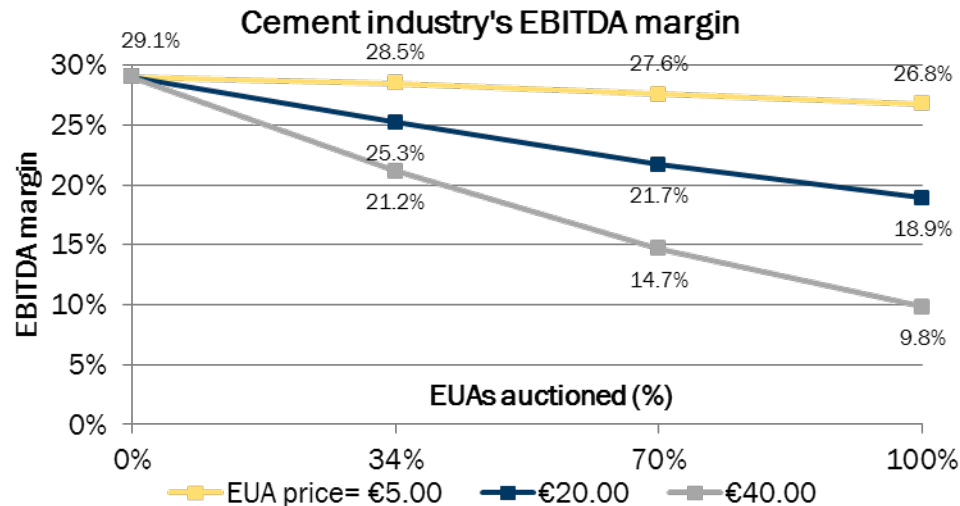
Source: FTI Consulting analysis

The effect of a stronger ETS on the composition of the cement industry's revenues



Source: FTI Consulting analysis

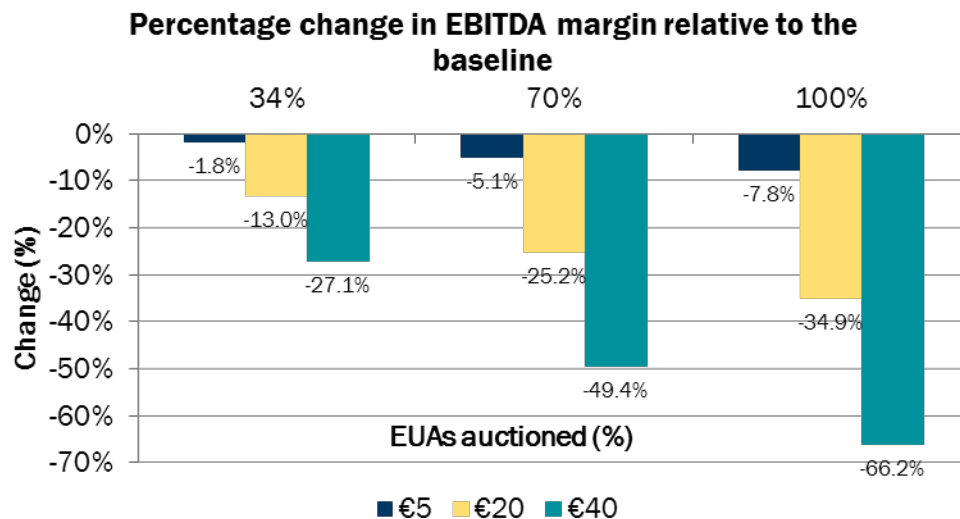
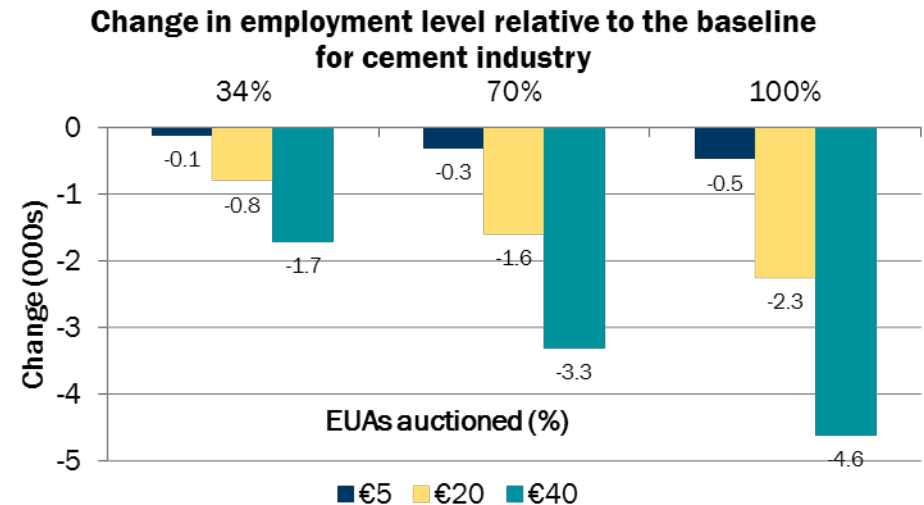
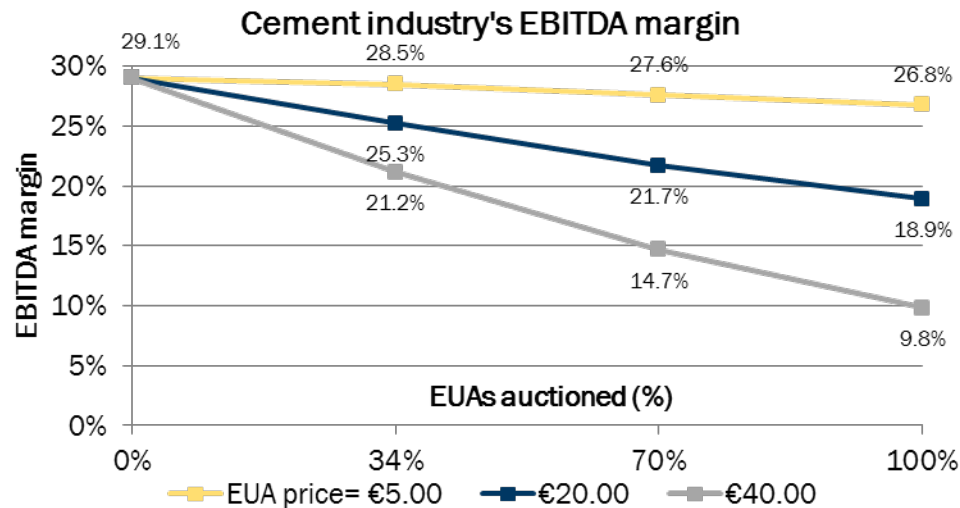
The effect of a stronger ETS on the cement industry's profitability and employment



- As a greater proportion of EUAs are auctioned, the greater is the negative impact on EBITDA margins and employment levels
- The EBITDA margin with 34% EUAs auctioned and €40 carbon price is equivalent to 70% auctioned and €20 carbon price
- At a carbon price of €20 and with a 70% auction rate the estimated decline in employment is approximately 1,600

Source: FTI Consulting analysis

The effect of a stronger ETS on the cement industry's profitability and employment



- As a greater proportion of EUAs are auctioned, the greater is the negative impact on EBITDA margins and employment levels
- The EBITDA margin with 34% EUAs auctioned and €40 carbon price is equivalent to 70% auctioned and €20 carbon price
- At a carbon price of €20 and with a 70% auction rate the estimated decline in employment is approximately 1,600

Source: FTI Consulting analysis

The cement industry's output, revenue, profit and employment in various scenarios – separately for coastal and inland plants

Coastal

Scenario	Carbon price	% EUA auctioned	Price	Volume	Revenue	Costs	EBITDA	EBITDA margin
	€/tonne of CO2	%	€/ t cement	million tonnes	€ billions	€ billions	€ billions	0.0%
0	14.2	0%	69.7	134.5	9.4	6.9	2.5	26.2%
1	5	34%	70.0	134.2	9.4	7.0	2.4	25.6%
2	5	70%	70.4	133.8	9.4	7.1	2.3	24.4%
3	5	100%	70.7	133.5	9.4	7.2	2.2	23.5%
4	20	34%	71.4	132.7	9.5	7.4	2.0	21.6%
5	20	70%	73.1	131.0	9.6	7.9	1.7	17.2%
6	20	100%	74.4	129.6	9.6	8.3	1.3	13.7%
7	40	34%	73.3	130.8	9.6	8.0	1.6	16.6%
8	40	70%	76.6	127.3	9.8	8.9	0.8	8.4%
9	40	100%	79.4	124.5	9.9	9.7	0.2	2.1%

Inland

0	14.2	0%	78.5	89.7	7.0	4.7	2.3	32.8%
1	5	34%	79.0	89.5	7.1	4.8	2.3	32.5%
2	5	70%	79.8	89.2	7.1	4.9	2.3	31.7%
3	5	100%	80.5	89.0	7.2	4.9	2.2	31.2%
4	20	34%	81.8	88.5	7.2	5.1	2.2	30.1%
5	20	70%	85.2	87.4	7.4	5.4	2.0	27.5%
6	20	100%	87.9	86.4	7.6	5.7	1.9	25.5%
7	40	34%	85.7	87.2	7.5	5.4	2.0	27.1%
8	40	70%	92.3	84.9	7.8	6.1	1.8	22.6%
9	40	100%	97.8	83.0	8.1	6.6	1.6	19.2%

Source: FTI Consulting analysis

The effect of a stronger ETS on coastal and inland plant output, revenue, cost, and profitability

Coastal

Scenario	Carbon price	% EUA auctioned	Price	Volume	Revenue	Costs	EBITDA	EBITDA margin
	€/tonne of CO2	%	€/ t cement	million tonnes	€ billions	€ billions	€ billions	0.0%
0	14.2	0%						
1	5	34%	0.23	-0.23	0.01	0.07	-0.06	-0.6%
2	5	70%	0.64	-0.66	0.04	0.20	-0.16	-1.8%
3	5	100%	0.98	-1.02	0.06	0.30	-0.24	-2.7%
4	20	34%	1.67	-1.73	0.10	0.51	-0.41	-4.6%
5	20	70%	3.32	-3.44	0.20	1.00	-0.81	-9.0%
6	20	100%	4.70	-4.87	0.27	1.40	-1.13	-12.5%
7	40	34%	3.59	-3.72	0.21	1.08	-0.87	-9.7%
8	40	70%	6.90	-7.15	0.38	2.02	-1.64	-17.8%
9	40	100%	9.66	-10.01	0.50	2.76	-2.25	-24.1%

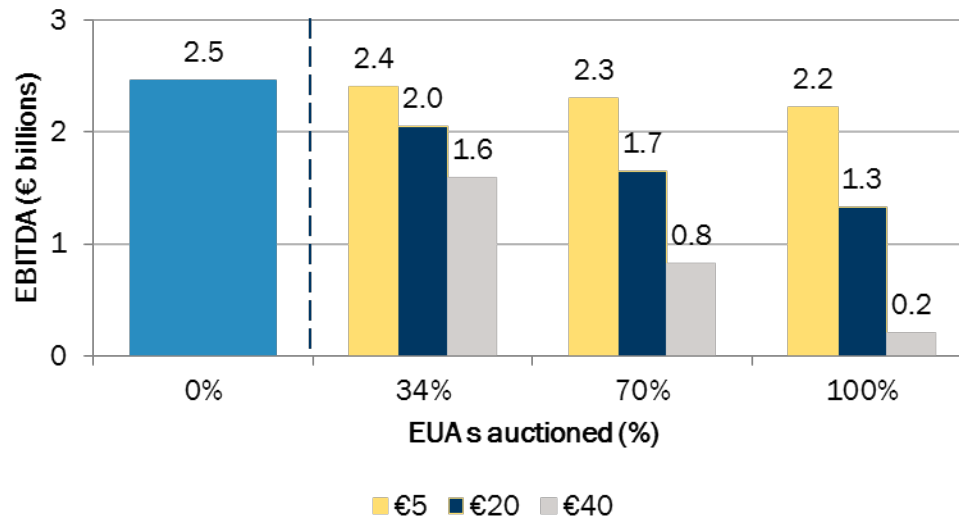
Inland

0	14.2	0%						
1	5	34%	0.45	-0.16	0.03	0.05	-0.02	-0.4%
2	5	70%	1.28	-0.44	0.08	0.13	-0.05	-1.1%
3	5	100%	1.97	-0.68	0.12	0.20	-0.08	-1.7%
4	20	34%	3.33	-1.15	0.20	0.34	-0.13	-2.8%
5	20	70%	6.64	-2.30	0.40	0.67	-0.27	-5.3%
6	20	100%	9.40	-3.25	0.56	0.93	-0.37	-7.3%
7	40	34%	7.18	-2.48	0.43	0.72	-0.29	-5.7%
8	40	70%	13.80	-4.77	0.80	1.34	-0.54	-10.3%
9	40	100%	19.31	-6.67	1.08	1.83	-0.75	-13.6%

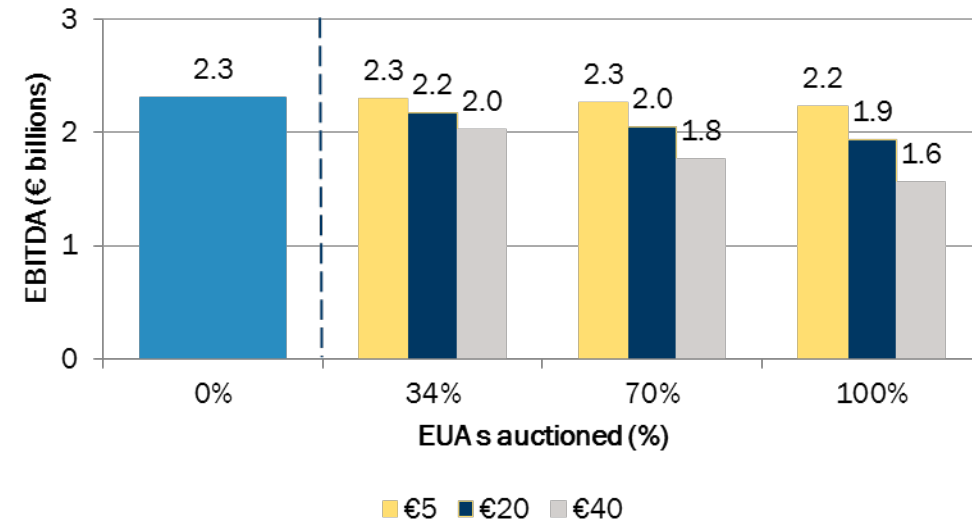
Source: FTI Consulting analysis

EBITDA of inland producers is resilient to higher EUA auctioning and carbon prices

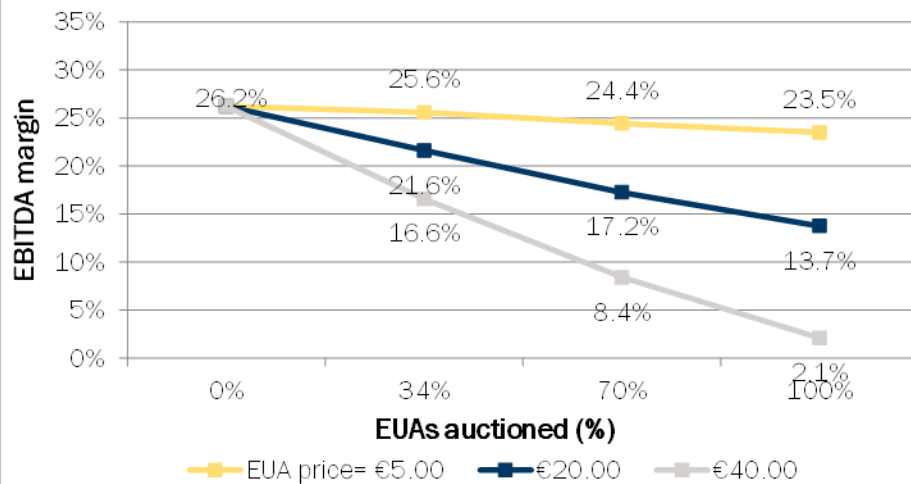
Coastal cement producers' EBITDA



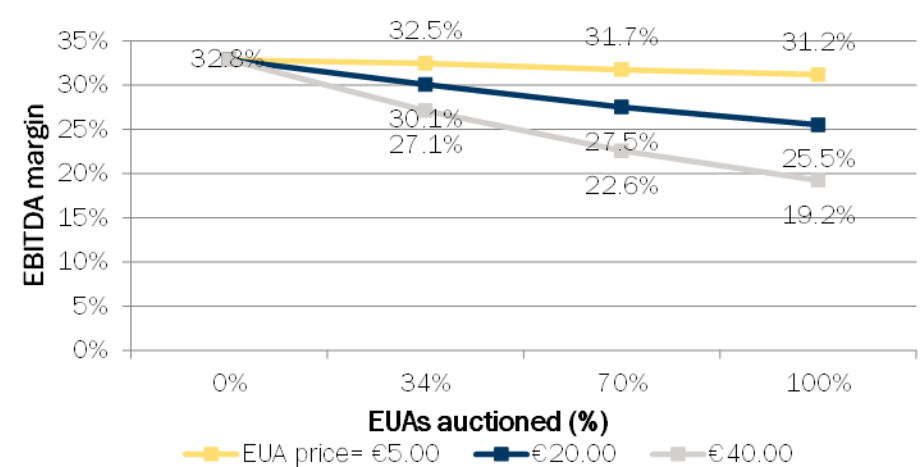
Inland cement producers' EBITDA



EBITDA margin- Coastal



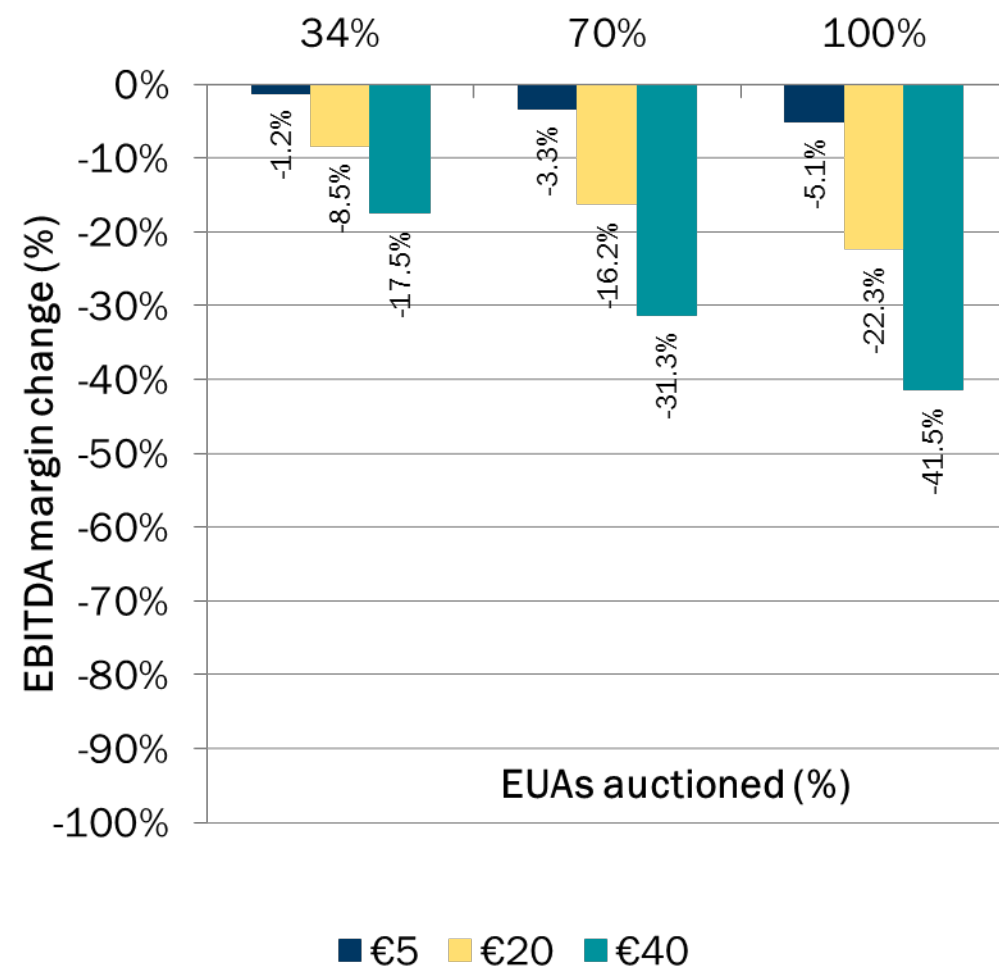
EBITDA margin- Inland



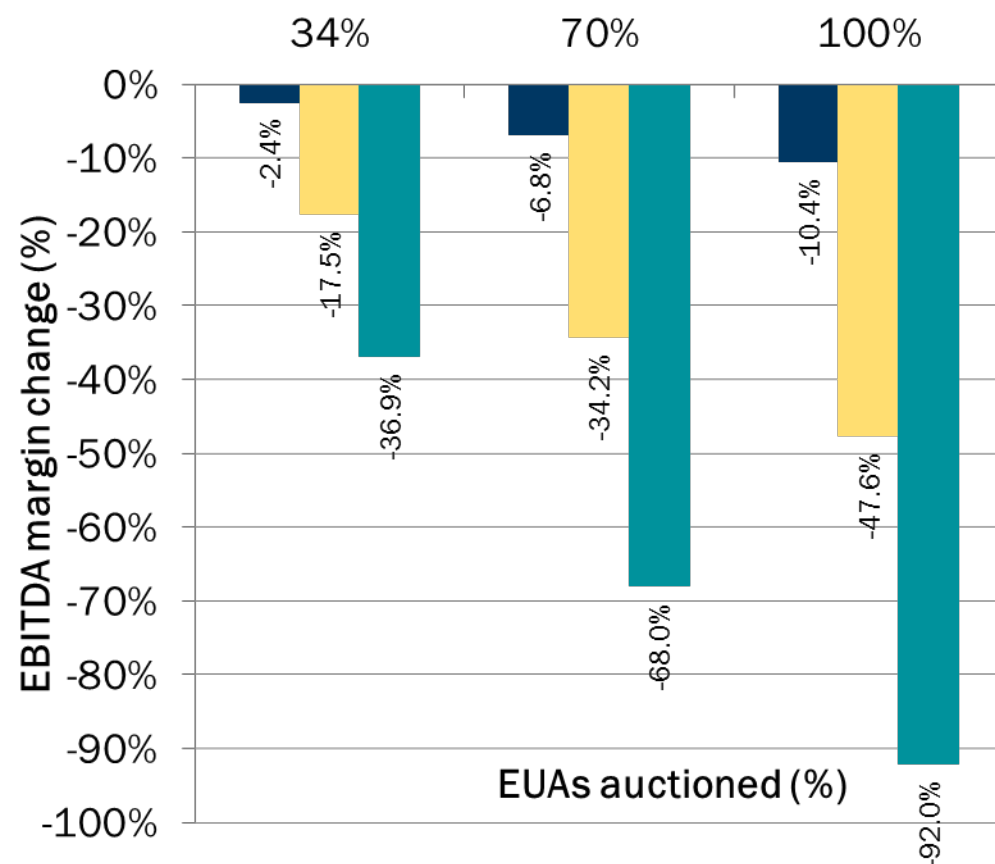
Source: FTI Consulting analysis

Coastal versus inland plants – percentage change in EBITDA

Percentage change in EBITDA margin relative to the baseline- Inland



Percentage change in EBITDA margin relative to the baseline- Coastal



Source: FTI Consulting analysis

COMPASS LEXECON

Chemicals sector analysis

Several activities of the chemicals sector are included in the EU ETS

Chemicals sector in the EU ETS

- Annexes I to the Directive 2003/87/EC and to the Directive 2009/29/EC list the activities included in the EU ETS
- All of the activities related to the chemicals sector can be connected to a NACE code however a NACE code contains several activities complicating analysis of emission data
- Description of some activities is ambiguous, e.g. Production of bulk organic chemicals by cracking, reforming, partial or full oxidation *or by similar processes*, with a production capacity exceeding 100 t per day:
 - Ethylene, for example, is produced in installations exceeding 100 t capacity per day however it is **arguable if its production process is similar to cracking or reforming**

	ETS Phase 1	ETS Phase 2	ETS Phase 3
Period	2005-2007	2008-2012	2013-2020
Chemicals included in the EU ETS	<ul style="list-style-type: none"> • No chemical products were explicitly named in Annex I to the Directive 2003/87/EC • Steam production (common in the chemical industry) is included in the ETS <ul style="list-style-type: none"> – steam is produced in “combustion installations with a rated thermal input exceeding 20 MW” 	<ul style="list-style-type: none"> • Production sites producing ethylene and propylene (steam crackers) with a production capacity exceeding 50000 t per year, and • Combustion plants producing carbon black with a thermal input exceeding 20 MW • Many production processes that consume steam 	<ul style="list-style-type: none"> • Annex I to Directive 2009/29/EC amending Directive 2003/87/EC explicitly lists several activities, i.e. production of: <ul style="list-style-type: none"> – Carbon black, Nitric acid, Adipic acid, Glyoxal and glyoxylic acid, Ammonia, Bulk organic chemicals*, Hydrogen and synthesis gas, Soda ash and sodium bicarbonate • 25 petrochemicals are not explicitly named, but arguably included under bulk organic chemicals, e.g.: <ul style="list-style-type: none"> – Ethylene, propylene, aromatics, etc. • Many production processes that consume steam

Source: Ecofys, Fraunhofer, Öko-Institut: Methodology for the free allocation of emission allowances in the EU ETS post 2012. Sector report for the chemical industry (2009)

* Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 t per day

NACE 4 codes aggregate different activities and description of some activities is ambiguous

No	Annex I category of activities	NACE code	Description NACE
1	Production of carbon black	2413	Manufacture of other inorganic basic chemicals
2	Production of nitric acid	2415	Manufacture of fertilizers and nitrogen compounds
3	Production of adipic acid	2414	Manufacture of other organic basic chemicals
4	Production of glyoxal and glyoxylic acid	2414	Manufacture of other organic basic chemicals
5	Production of ammonia	2415	Manufacture of fertilizers and nitrogen compounds
6	Production of bulk organic chemicals by cracking, reforming, partial or full oxidation or by similar processes, with a production capacity exceeding 100 t per day	2414, 2416, 2417	Manufacture of other organic basic chemicals (manufacture of plastics and synthetic rubber in primary forms)
7	Production of hydrogen (H ₂) and synthesis gas	2411	Manufacture of industrial gases
8	Production of soda ash (Na ₂ CO ₃) and sodium bicarbonate (NaHCO ₃)	2413	Manufacture of other inorganic basic chemicals

Ethylene **may** belong to this activity but the description is ambiguous


Ethylene **belongs to 2414 – Manufacture of other organic basic chemicals – along with a large number of other products**

Source: Ecofys, Fraunhofer, Öko-Institut: Methodology for the free allocation of emission allowances in the EU ETS post 2012. Sector report for the chemical industry (2009)

The Association of Petrochemical Producers suggests that 25 petrochemicals *possibly* belong to the ambiguous description

No	Petrochemicals possibly to be benchmarked according to APPE (APPE 2009a)		
1	Ethylene/Propylene	14	Vinyl chloride
2	Aromatics	15	Styrene
3	Cyclohexane	16	Akrylnitril
4	Aniline (incl. Nitrobenzene)	17	Cumene
5	P-Xylenes	18	Phenol
6	Terephthalic acid / Dimethylpyrrolidine	19	Acetone
7	Butadiene	20	Propylene oxide
8	Polyethylene	21	2-Ethylhexanol
9	Polypropylene	22	Polyethylene terephthalate
10	Polystyrene	23	Caprolactam
11	Polyvinylchloride	24	Ethylene propylene diene M-class rubber
12	Ethylene oxide	25	Acrylic acid
13	Monoethylene glycol		

Source: Ecofys, Fraunhofer, Öko-Institut: Methodology for the free allocation of emission allowances in the EU ETS post 2012. Sector report for the chemical industry (2009)



Production processes in the chemicals sector are complex and emissions are hard to measure and allocate

■ Illustrative example – Ethylene production

- Ethylene is one of the high value chemicals (e.g. propylene, butadiene, benzene, hydrogen) of the **steam cracking process** and it is the petrochemical with the highest production volume in the EU
- The steam cracking process can be operated with different feedstocks (naphta, gas oil etc) and **the feedstock influences the product mix as well as the specific energy consumption and the specific CO2 emissions. Additionally, supplemental feed and interchangeability of energy carriers also have a large impact on emissions**
- **5 marketable products (ethylene, propylene, butadiene, benzene and hydrogen) are produced at the same time and it is impossible to allocate the emissions to each of the products produced**
- There are some crackers being operated in parallel lines. There is the possibility to crack the feedstock in line one and to separate the cracked gas in line two. As a consequence most of the emissions emerge in the line one cracker whereas the product is leaving line two. This results in high specific emissions in line 1 and low emissions in line 2, which **does not reflect the actual emission efficiency of the cracker**
- The steam crack process belongs to NACE code 2414 (Manufacture of other organic basic chemicals) but NACE code 2414 includes several other processes (e.g. Production of adipic acid, Production of glyoxal and glyoxylic acid etc.) that **complicates the analysis of the emission data**
- Ethylene production includes 3 sources of carbon emissions: **direct, steam and indirect emissions**, further complicating the modelling

There are 20 sectors in the chemicals industry at NACE 4 level

DG. Manufacture of chemicals, chemical products and man-made fibres

24 Manufacture of chemicals and chemical products

241 Manufacture of basic chemicals

2411 - Manufacture of industrial gases

2412 - Manufacture of dyes and pigments

2413 - Manufacture of other inorganic basic chemicals

2414 - Manufacture of other organic basic chemicals

2415 - Manufacture of fertilizers and nitrogen compounds

2416 - Manufacture of plastics in primary forms

2417 - Manufacture of synthetic rubber in primary forms

242 Manufacture of pesticides and other agro-chemical products

2420 - Manufacture of pesticides and other agro-chemical products

243 Manufacture of paints, varnishes and similar coatings, printing ink and mastics

2430 - Manufacture of paints, varnishes and similar coatings, printing ink and mastics

244 Manufacture of pharmaceuticals, medicinal chemicals and botanical products

2441 - Manufacture of basic pharmaceutical products

2442 - Manufacture of pharmaceutical preparations

245 Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations

2451 - Manufacture of soap and detergents, cleaning and polishing preparations

2452 - Manufacture of perfumes and toilet preparations

246 Manufacture of other chemical products

2461 - Manufacture of explosives

2462 - Manufacture of glues and gelatines

2463 - Manufacture of essential oils

2464 - Manufacture of photographic chemical material

2465 - Manufacture of prepared unrecorded media

2466 - Manufacture of other chemical products n.e.c.

247 Manufacture of man-made fibres

2470 - Manufacture of man-made fibres

Source: Eurostat

COMPASS LEXECON

18 sectors are on the CL list: the majority due to trade intensity; 4 due to joint criteria and 3 to qualitative reasons

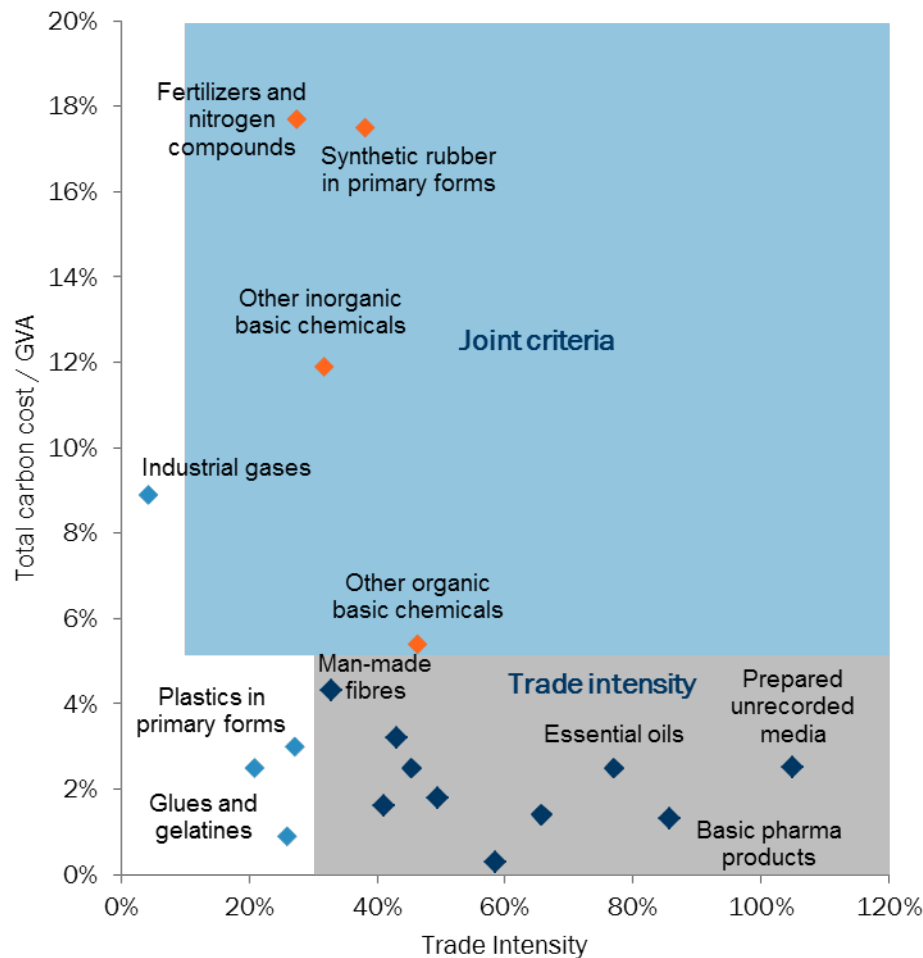
NACE 4	Sector	Direct costs / GVA	Indirect costs / GVA	Total costs / GVA	Trade	CL
2411	Manufacture of industrial gases	1,40%	7,50%	8,90%	4,20%	PART
2412	Manufacture of dyes and pigments	0,70%	1,40%	3,20%	43,10%	YES
2413	Manufacture of other inorganic basic chemicals	4,80%	6,00%	11,90%	31,70%	YES
2414	Manufacture of other organic basic chemicals	2,50%	2,20%	5,40%	46,30%	YES
2415	Manufacture of fertilizers and nitrogen compounds	14,00%	3,70%	70,20%	27,40%	YES
2416	Manufacture of plastics in primary forms	1,40%	1,70%	3,00%	27,10%	YES
2417	Manufacture of synthetic rubber in primary forms	>5% and < 30%	<5%	>5% and < 30%	38,10%	YES
2420	Manufacture of pesticides other agro-chemical products	1,20%	0,40%	1,60%	41,10%	YES
2430	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	<5%	0,40%	<5%	20,80%	PART
2441	Manufacture of basic pharmaceutical products	0,40%	0,90%	1,30%	85,80%	YES
2442	Manufacture of pharmaceutical preparations	0,00%	0,20%	0,30%	58,60%	YES
2451	Manufacture of soap and detergents, cleaning and polishing preparations	<5%	0,40%	<5%	23,10%	NO
2452	Manufacture of perfumes and toilet preparations	<5%	0,30%	<5%	45,30%	YES
2461	Manufacture of explosives	<5%	0,30%	<5%	15,90%	NO
2462	Manufacture of glues and gelatines	0,30%	0,60%	0,90%	25,90%	PART
2463	Manufacture of essential oils	<5%	0,30%	<5%	77,00%	YES
2464	Manufacture of photographic chemical material	0,30%	1,10%	1,40%	65,70%	YES
2465	Manufacture of prepared unrecorded media	<5%	<5%	<5%	105,10%	YES
2466	Manufacture of other chemical products n.e.c	1,00%	0,80%	1,80%	49,60%	YES
2470	Manufacture of man-made fibres	1,50%	2,80%	4,30%	32,80%	YES

Source: Delft "Carbon Leakage and the Future of the EU ETS Market", 2013

Joint carbon cost and trade intensity reason
 Trade intensity only reason
 Other criteria

Chemicals sectors fall under a mix of carbon leakage criteria

Chemicals carbon leakage sectors



Chemicals sectors qualify for the carbon leakage list via several different criteria

Four qualify via the joint carbon cost and trade intensity criteria:

- Other organic basic chemicals
- Other inorganic basic chemicals
- Synthetic rubber in primary forms
- Fertilizers and nitrogen compounds

The majority (10 sectors) qualify as a result of trade intensity only, including:

- Basic pharmaceutical products
- Pharmaceutical preparations

For the four sectors that qualify through “Other” criteria, only the manufacture of plastics in primary forms qualifies in its entirety. For the other three, only certain activities are eligible:

- Industrial gases:
 - Hydrogen
 - Nitrogen
 - Oxygen
- Glues and gelatines:
 - Gelatine and its derivatives
- Paints, varnishes and similar coatings, printing ink and mastics:
 - Prepared pigments, opacifiers and colours, vitrifiable enamels and glazes, engobes, liquid lustres etc.

Source: Delft “Carbon Leakage and the Future of the EU ETS Market”, 2013

Size and profitability of these sectors vary considerably

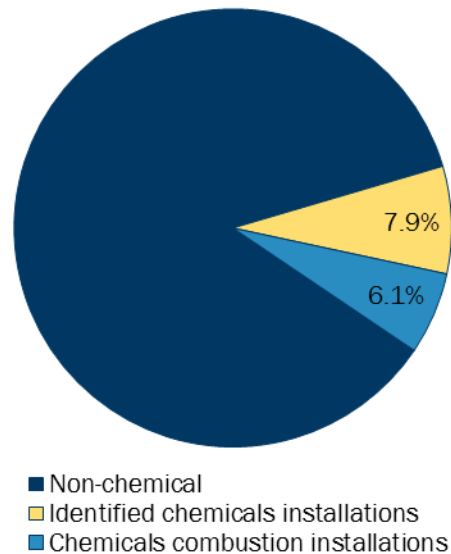
NACE 4	Sector	Turnover (€m) Avg. 2003-10	GVA margin Avg. 2003-10	EBITDA margin Avg. 2003-10	Employment Avg. 2003-10
2442	Pharmaceutical preparations	177,734	35.0%	18.4%	513,463
2414	Other organic basic chemicals	124,816	20.0%	11.7%	161,963
2416	Plastics in primary forms	97,148	18.9%	8.2%	181,388
2430	Paints, varnishes and similar coatings...	40,974	27.5%	10.0%	166,900
2466	Other chemical products n.e.c.	38,346	24.7%	10.4%	119,875
2452	Perfumes and toilet preparations	36,534	25.1%	10.2%	141,175
2420	Pesticides and other agro-chemical products	33,458	24.1%	10.4%	27,500
2413	Other inorganic basic chemicals	27,107	25.1%	10.0%	79,229
2415	Fertilizers and nitrogen compounds	18,375	20.1%	9.7%	56,900
2441	Basic pharmaceutical products	18,362	36.6%	21.4%	60,250
2411	Industrial gases	12,886	35.2%	19.9%	12,454
2412	Dyes and pigments	10,956	26.2%	8.3%	37,657
2470	Man-made fibres	10,767	23.6%	7.5%	42,763
2462	Glues and gelatines	6,043	27.2%	11.1%	22,460
2463	Essential oils	4,961	31.9%	12.2%	18,675
2417	Synthetic rubber in primary forms	4,887	14.3%	5.2%	14,300
2464	Photographic chemical material	4,280	29.7%	10.0%	13,588
2465	Prepared unrecorded media	771	16.2%	3.3%	2,975
Total		668,406			1,673,513

Source: Eurostat (average of 2003-2010)

Note: EBITDA margin is calculated as Gross operating surplus/Turnover. GVA margin is calculated as Value added at factor cost/Turnover.

The chemicals sectors account for ~14% of industrial emissions

Chemicals' share of industrial emissions



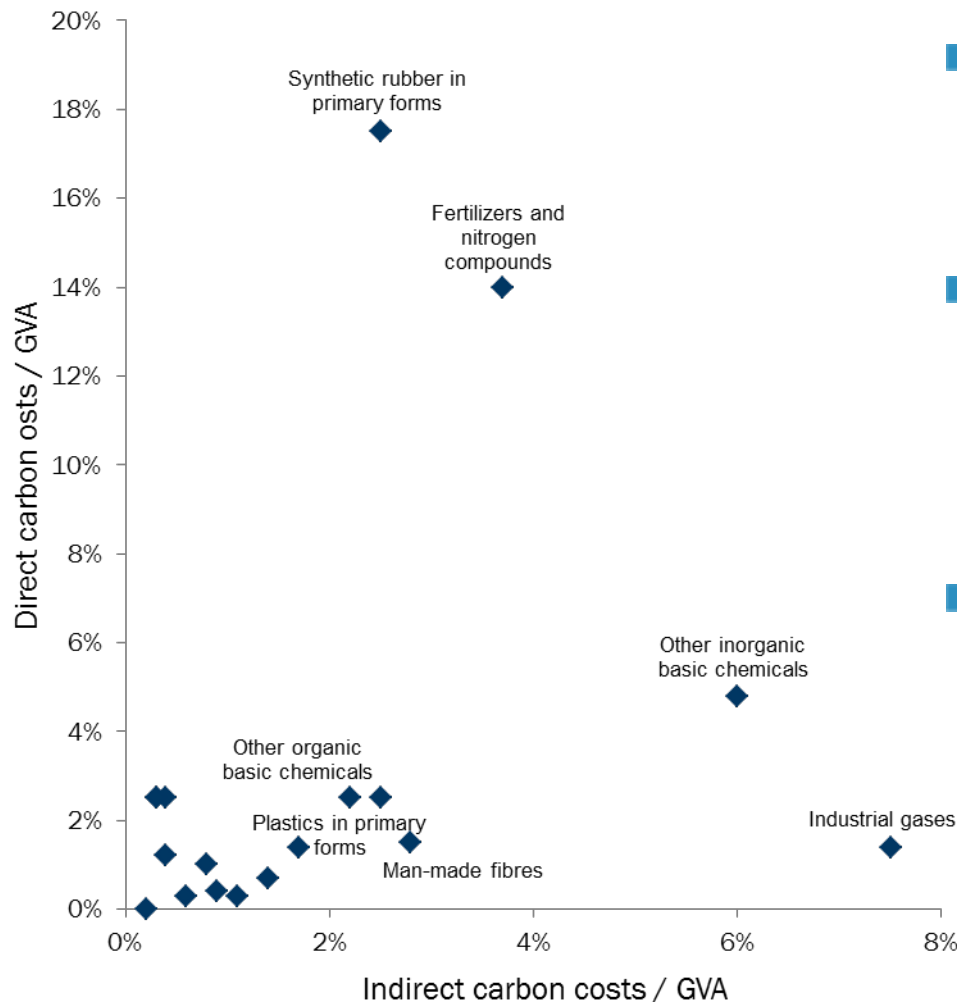
NACE 4	Identified chemicals sector	Share of industrial CO ₂ emissions
2414	Other organic basic chemicals	2.0%
2413	Other inorganic basic chemicals	1.0%
2410	Basic chemicals	1.0%
2416	Plastics in primary forms	0.9%
2400	Chemicals and chemical products	0.6%
2466	Other chemical products n.e.c.	0.6%
2415	Fertilizers and nitrogen compounds	0.5%
2470	Man-made fibres	0.2%
2441	Basic pharmaceutical products	0.2%
2411	Industrial gases	0.2%
2420	Pesticides and other agro-chemical products	0.1%
2442	Pharmaceutical preparations	0.1%
2417	Synthetic rubber in primary forms	0.1%
2412	Dyes and pigments	0.1%
2430	Paints, varnishes and similar coatings...	0.1%
2451	Soap and detergents, cleaning and polishing	0.1%
2464	Photographic chemical material	0.0%
2462	Glues and gelatines	0.0%
2460	Other chemical products	0.0%
2452	Perfumes and toilet preparations	0.0%
2440	Pharmaceuticals, medicinal chemicals...	0.0%
2461	Explosives	0.0%
2463	Essential oils	0.0%
2465	Prepared unrecorded media	0.0%
Total		7.9%

Source: CITL (2005/6), Delft "Carbon Leakage and the Future of the EU ETS Market", 2013

Notes: Figures are indicative, Chemicals sector NACE codes do not match exactly CITL emissions data, and thus emissions data is not available for every chemicals installation. Figures in table are based upon emissions from installations identified with a chemicals NACE code, and the industrial emissions level in Delft Report. The other portion of chemical emissions are assumed to be emitted by installations identified as combustion installations

Carbon costs of most chemicals are typically less than 5% of GVA; 4 sectors stand out

Chemicals carbon leakage sectors



■ For the majority of chemicals sectors, carbon costs are low, but the heterogeneity across the industry is evident

■ Total carbon cost/GVA ranges from 0.3% for the manufacture of pharmaceutical preparations, to 17.7% for the manufacture of fertilisers and nitrogen compounds (NB the range of 5%-30% is given for the manufacture of synthetic rubber in primary forms)

■ 4 chemicals sectors have a carbon cost of greater than 5% of GVA:

- Synthetic rubber in primary forms
- Fertilizers and nitrogen compounds
- Other inorganic basic chemicals
- Industrial gases

■ Note that the Delft report presented range estimates of <5% or 5%-30% for carbon costs for a number of sectors. For the range estimates the mid-point 17.5% or 2.5%, respectively, are presented here

Source: Delft "Carbon Leakage and the Future of the EU ETS Market", 2013

Note: Carbon costs were calculated assuming 75% auctioning of EUAs and an EUA price of €30.

Margins and exposure to carbon costs vary across the industry

NACE 4	Sector	Turnover Avg. 2003-10	Total costs/GVA	GVA margin Avg. 2003-10	EBITDA margin Avg. 2003-10
2415	Fertilizers and nitrogen compounds	18,375	17.7%	20.1%	9.7%
2417	Synthetic rubber in primary forms	4,887	17.5%*	14.3%	5.2%
2413	Other inorganic basic chemicals	27,107	11.9%	25.1%	10.0%
2411	Industrial gases	12,886	8.9%	35.2%	19.9%
2414	Other organic basic chemicals	124,816	5.4%	20.0%	11.7%
2470	Man-made fibres	10,767	4.3%	23.6%	7.5%
2412	Dyes and pigments	10,956	3.2%	26.2%	8.3%
2416	Plastics in primary forms	97,148	3.0%	18.9%	8.2%
2430	Paints, varnishes and similar coatings	40,974	2.5%*	27.5%	10.0%
2452	Perfumes and toilet preparations	36,534	2.5%*	25.1%	10.2%
2463	Essential oils	4,961	2.5%*	31.9%	12.2%
2465	Prepared unrecorded media	771	2.5%*	16.2%	3.3%
2466	Other chemical products n.e.c.	38,346	1.8%	24.7%	10.4%
2420	Pesticides and other agro-chemicals	33,458	1.6%	24.1%	10.4%
2464	Photographic chemical material	4,280	1.4%	29.7%	10.0%
2441	Basic pharmaceutical products	18,362	1.3%	36.6%	21.4%
2462	Glues and gelatines	6,043	0.9%	27.2%	11.1%
2442	Pharmaceutical preparations	177,734	0.3%	35.0%	18.4%
Average			5.0%	25.6%	11.0%

Source: Eurostat (average of 2003-2010), Delft "Carbon Leakage and the Future of the EU ETS Market", 2013

*Value represents estimate from a range.

Over-allocation in select companies of the chemicals industry ranges from 10% to 66%

The table below shows the extent of the over-allocation of EUAs to chemical companies' operations within a specified country, or specific installation. In the sample, over-allocation ranged from 10% to 66% of measured emissions over Phase II of the ETS.

Company/ Installation	Country	Description	Emissions (2008-2012 average)	Allocations (2008-2012 average)	Over-allocation (2008-2012 average)	Value of over- allocation (EUA-€30)	Over-allocation as percentage of measured emissions
BASF	Germany	The world's largest diversified chemicals company. Ten chemicals installations included	2,284,930	2,624,348	339,418	10,182,546	15%
DOW Chemical	Germany	US company, and world's third largest diversified chemicals company. Six installations included	767,100	1,011,574	244,474	7,334,214	32%
Polimeri	Italy	The petrochemicals arm of energy company ENI. Nine installations included	3,685,605	5,115,453	1,429,848	42,895,452	39%
Unicalce	Italy	Leading producer of lime and chemical products in Italy. Five chemicals installations included	523,518	778,953	255,435	7,663,056	49%
Grangemouth Chemicals	United Kingdom	Installation operated by INEOS, one of the ten largest chemical companies in the world	1,438,354	1,579,835	141,480	4,244,412	10%
Runcorn Halochemicals	United Kingdom	Installation operated by Mexichem, a Mexican chemicals company	208,153	344,639	136,486	4,094,592	66%

Source: CITL

Note: CL sector NACE codes do not match exactly CITL installation emissions data, and emissions data is not available for every installation. Based upon only those emissions from installations with a chemicals NACE code.

Detailed results of scaling up of costs



Structure of this section

- Overview of CL groups
 - Carbon cost group
 - Trade intensity group
 - Joint group
 - Other groups
- Methodology to scale up results of modelling
 - Overview of our approach
 - Modelling scenarios
- Preliminary results
 - Overall
 - By CL groups

The CL sectors account for over € 358bn EBITDA; 3.1% of GDP

Trade intensity is by far the largest group in terms of turnover

Total turnover of Carbon Leakage sectors was € 3.5 trillion on average during 2003-2010

■ This is approx. 30% of the EU's GDP during 2003-2010

Total EBITDA of Carbon Leakage sectors was € 358 billion on average during 2003-2010

■ This is approx. 3.1% of the EU's GDP during 2003-2010

Trade intensity and joint groups drive the results

■ These two groups account for 93% of total turnover and total EBITDA

Carbon cost group accounts for only 1% of output of CL sectors

	Turnover (€m) Avg. 2003-10	Turnover %	GVA (€m) Avg. 2003-10	GVA margin	EBITDA (€m) Avg. 2003-10	EBITDA margin	Employment	Employment %
Carbon cost	23,426	1%	9,306	40%	5,901	25%	75,744	0%
Joint criteria	1,027,929	29%	154,411	15%	75,185	7%	1,898,289	12%
Trade intensity	2,237,334	64%	674,496	30%	259,511	12%	12,636,136	82%
Qualitative	154,090	4%	34,771	23%	12,647	8%	588,732	4%
Sub NACE-4 level	57,470	2%	10,724	19%	5,024	9%	160,222	1%
Total	3,500,248	100%	883,708	25%	358,269	12%	15,359,122	100%

Note: Qualitative and sub NACE-4 level sectors have been excluded from the analysis.

Estimates of the share of freely allocated EUAs by Carbon Leakage criteria

CL criteria	Share of freely allocated EUAs (2013)	Number of freely allocated EUAs (millions)
Steel	23%	176
Cement	17%	129
Carbon cost	20%	161
Trade intensity	26%	214
Joint	45%	366
Quantitative, sub NACE 4 level	1%	8
Qualitative	2%	20
Total	95%	768

- We assumed that the Carbon Leakage sectors would receive 95% of EUAs freely allocated to industry, which was equivalent to its share of industrial emissions stated in the Delft report
- The Carbon Leakage groups' relative shares of these freely allocated EUAs in 2013 were estimated based on the Delft report's analysis weighted by 2013 EC information on some individual sectors' shares of freely allocated EUAs in phase 3 of the ETS (2013-2020)
- Comparing these figures indicated that using the Delft report's figures would lead to an overestimation of the carbon cost group's share of allocations by 9 percentage points, with the steel sector's share underestimated by 9 percentage points
- Applying this information to the Delft report figures:
 - the carbon cost group's share of emissions/allocations fell by 9 percentage points to 20%
 - the joint group's share increased by 9 percentage points to 45%
 - the remaining freely allocated EUAs were split between the other carbon leakage criteria based on their relative shares of industrial emissions stated in the Delft report

Source: FTI estimates based on EC communication (Oct. 2013) and Delft "Carbon Leakage and the Future of the EU ETS Market" (2013)

The cement sector is a good proxy for the carbon cost group

Lime is more carbon intensive but even less traded than cement

■ Only two sectors were included by the EC on the carbon leakage list under this criterion: the manufacture of cement, and lime

■ These sectors:

- Were deemed by the EC to be highly sensitive to an increase in carbon costs
- The EC's criterion was that production costs would increase by >30% (assuming 75% auctioning of EUAs at a price of €30)
- Have relatively low trade intensity, which may reduce the risk of carbon leakage

NACE Code	Sector	Turnover (€m) Avg. 2003-10	GVA margin^ Avg. 2003-10	EBITDA margin^ Avg. 2003-10	Carbon cost/GVA Avg. 2005-06	Trade intensity Avg. 2005-07
2651	Cement	20,331	41%	27%	46%	7%
2652	Lime	3,094	31%	17%	65%	3%

Note: ^ GVA margin = Gross value added/Turnover, EBITDA margin = Gross operating surplus/Turnover

Source: Eurostat, FTI Consulting analysis

The steel sector is larger than the median of the joint criteria group but has similar margins, carbon costs and trade intensity

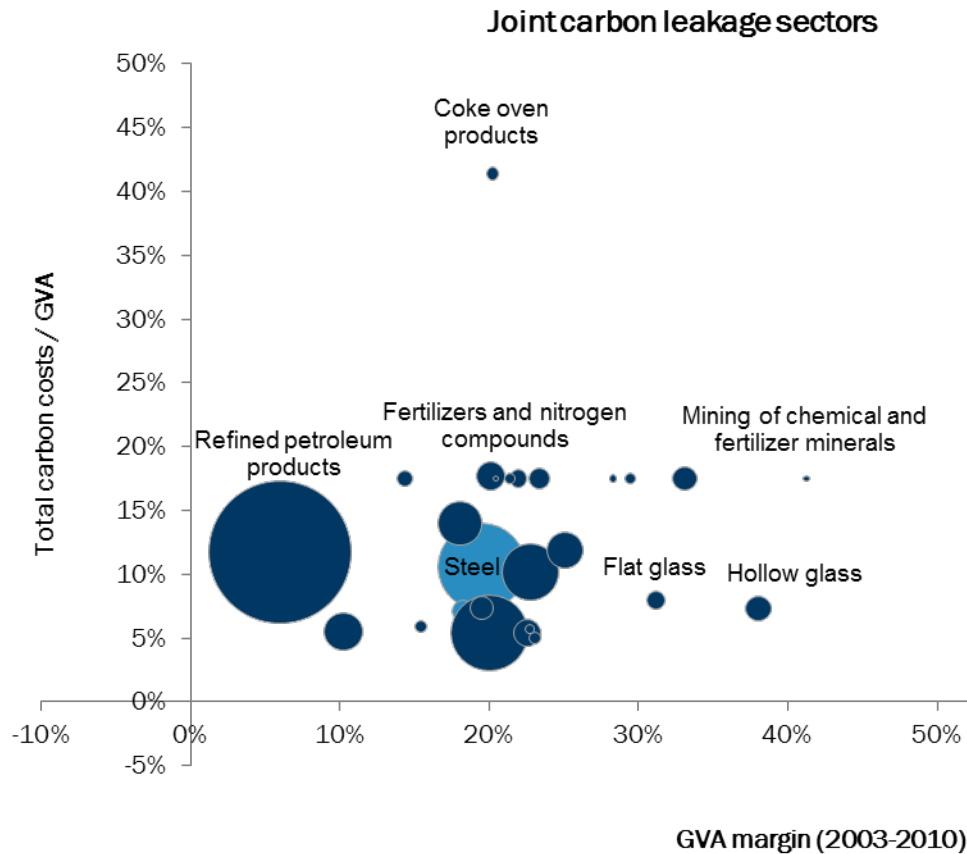
- Twenty-six sectors were included by the EC on the carbon leakage list under this criteria, including the steel sector
- These sectors:
 - Were deemed to be both sensitive to an increase in carbon costs and have a high trade intensity
 - The EC's criterion was that production costs would increase by >5% (assuming 75% auctioning of EUAs at a price of €30) and trade intensity is >10%
 - May have limited ability to pass through additional carbon costs to consumers, due to the intensity of the international competition they face

NACE 4 code	Top 10 Joint criteria sectors (by turnover)	Turnover (€m) Avg. 2003-10	GVA margin Avg. 2003-10	EBITDA margin Avg. 2003-10	Total carbon costs / GVA Avg. 2005-06	Trade intensity Avg. 2005-07
2320	Refined petroleum products	430,850	6%	4%	12%	35%
2710	Basic iron and steel and of ferro-alloys	165,157	19%	10%	11%	32%
2414	Other organic basic chemicals	124,816	20%	12%	5%	46%
2112	Paper and paperboard	67,917	23%	9%	10%	26%
2742	Aluminium production	42,233	18%	6%	14%	36%
2744	Copper production	31,443	10%	4%	6%	35%
2413	Other inorganic basic chemicals	27,107	25%	10%	12%	32%
2415	Fertilizers and nitrogen compounds	18,375	20%	10%	18%	27%
1583	Sugar	16,377	23%	12%	5%	20%
2613	Hollow glass	13,699	38%	13%	7%	24%
	Median of joint criteria group	9,975	22%	10%	12%	32%

Note: ^ GVA margin = Gross value added/Turnover, EBITDA margin = Gross operating surplus/Turnover

Source: Eurostat, Delft "Carbon Leakage and the Future of the EU ETS Market"(2013), FTI Consulting analysis

This steel sector is a good proxy for the joint criteria group 1/2



Key:  = approx. €70bn turnover

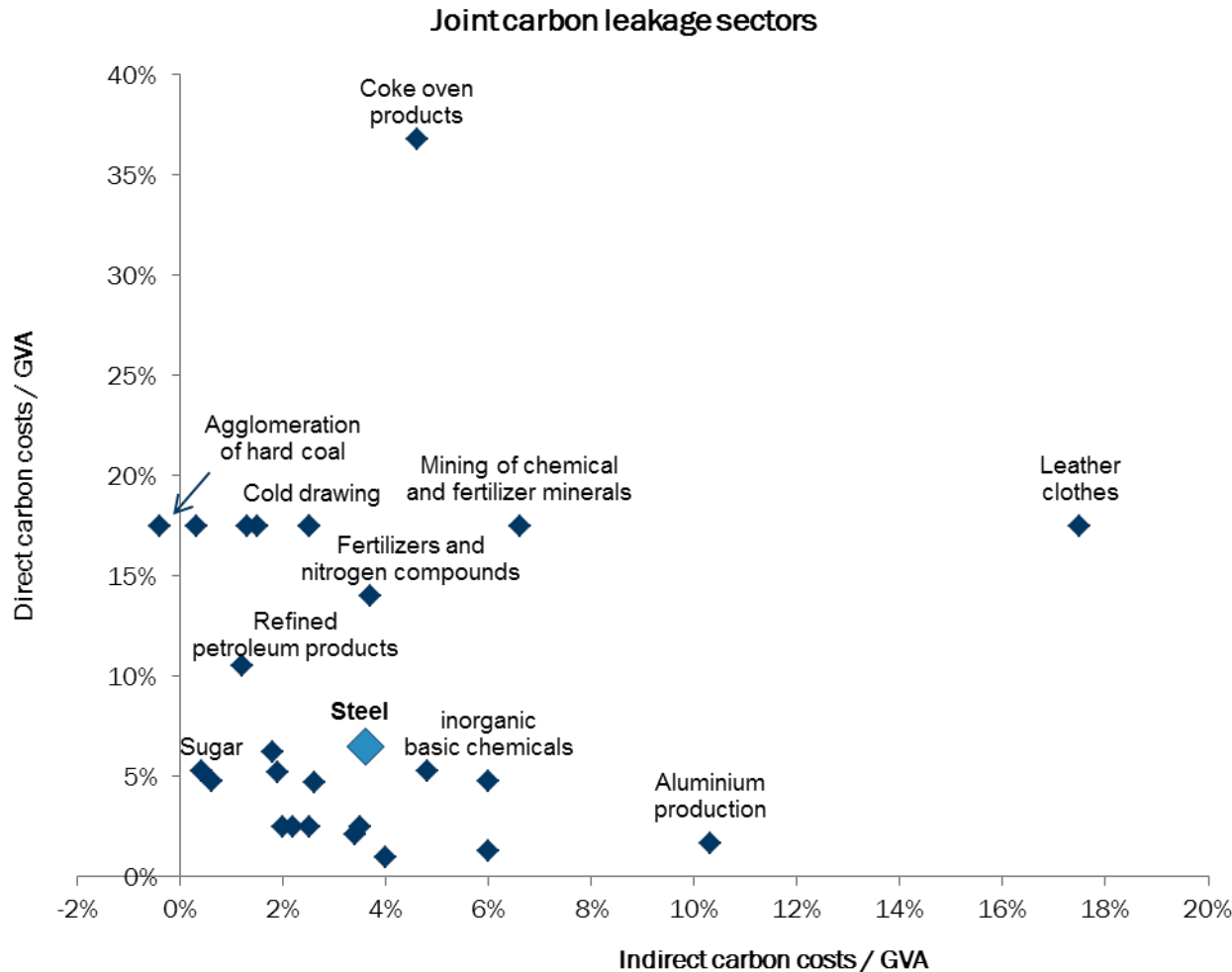
- Carbon costs as a percentage of margins and margins are among the most important indicators of how a sector will be impacted by carbon costs
- The steel sector represents the median of the joint criteria group in terms of carbon costs and GVA (gross) margins
- The steel sector had an average 19% GVA (gross) margin during 2003-2010, while its carbon costs/GVA was 11% (calculated with 75% auctioning of EUAs and an EUA price of €30)
 - This means that if the steel sector had to pay for carbon permits, its gross margin is estimated to decline by 11%, i.e. from 19% to 16.9%
- GVA margins for the rest of the joint criteria sectors range from 6% for the refined petroleum products sector to 65% for the agglomeration of hard coal sector
- Total carbon costs/GVA range from 5% for the preparation and spinning of cotton type fibres to 41% for the manufacturing of coke oven products sector

Source: Eurostat, Delft "Carbon Leakage and the Future of the EU ETS Market" (2013), FTI Consulting analysis

Note: For those sectors in which a carbon cost/GVA range was reported, a mid-range value has been used.

Carbon costs were calculated assuming 75% auctioning of EUAs and an EUA price of €30.

This steel sector is a good proxy for the joint criteria group 2/2



■ In terms of the relative importance of direct and indirect carbon costs, the steel sector again appears to be a good proxy for the joint criteria group

■ The steel sector was estimated to have 7% direct and 4% indirect carbon costs as a percentage of GVA at 75% auctioning and €30 EUA price

■ The rest of the joint criteria sectors cluster around the steel sector, with the exceptions of coke oven products, mining of chemical and fertilizer minerals and leather clothes

■ These sectors are among the smallest joint criteria sectors in terms of turnover

■ Note that the Delft report presented range estimates of 5%-30% for direct carbon costs for a number of sectors. For the range estimates the mid-point 17.5% is presented here

Source: Delft "Carbon Leakage and the Future of the EU ETS Market" (2013), FTI Consulting analysis

Note: For those sectors in which a carbon cost/GVA range was reported, a mid-range value has been used.

TRADE INTENSITY GROUP

The top 20 trade intensity sectors account for ~60% of the turnover of the 117 sectors in the group

- The EC included 117 sectors in this group:
- These sectors were deemed by the EC to be vulnerable to carbon leakage as a result of the intensity of the international competition faced
- They have small total carbon costs (less than 5% of gross value added, assuming a carbon price €30, and 75% auctioning)
- Meanwhile GVA margins are relatively strong (averaging 30% across the group, using 2003-2010 estimates)

NACE 4 code	Top 20 Trade Intensity Sector (by turnover)	Turnover Avg. 2003-10	Turnover% of group	Value added / turnover	EBITDA margin Avg. 2003-10	Total carbon costs/GVA Avg. 2005-06	Trade intensity Avg. 2005-07
2442	Pharmaceutical preparations	177,734	8%	35%	18%	0.3%	59%
1110	Crude petroleum and natural gas	143,408	7%	36%	32%	0.8%	60%
3530	Aircraft and spacecraft	89,735	4%	31%	8%	0.3%	80%
3120	Electricity distribution and control apparatus	86,229	4%	33%	6%	2.5%*	39%
3210	Electronic valves and tubes	63,207	3%	27%	9%	0.8%	81%
2956	Other special purpose machinery n.e.c.	62,924	3%	35%	8%	0.1%	49%
3002	Computers and other information processing eq	59,400	3%	23%	9%	0.3%	84%
3320	Instruments and appliances for measuring	58,331	3%	36%	11%	0.2%	60%
2924	Other general purpose machinery n.e.c.	56,880	3%	34%	9%	2.5%*	46%
3310	Medical and surgical equipment	53,743	2%	39%	15%	0.2%	73%
3110	Electric motors, generators and transformers	51,476	2%	29%	10%	2.5%*	44%
1822	Other outerwear	49,932	2%	26%	8%	0.2%	71%
3230	Television and radio receivers	49,764	2%	15%	6%	2.5%*	71%
2971	Electric domestic appliances	43,991	2%	24%	6%	2.5%*	41%
2875	Other fabricated metal products n.e.c.	43,528	2%	34%	12%	2.5%*	37%
2923	Non-domestic cooling and ventilation eq	42,799	2%	30%	8%	0.2%	35%
2466	Other chemical products n.e.c.	38,346	2%	25%	10%	1.8%	50%
2912	Pumps and compressors	37,308	2%	34%	10%	2.5%*	47%
2452	Perfumes and toilet preparations	36,534	2%	25%	10%	2.5%*	45%
2911	Engines and turbines, except aircraft, vehicle	36,055	2%	26%	9%	0.6%	51%
Total top 20		1,281,323	59%				
Total trade intensity group		2,337,334					
Median trade intensity group		9,089		30%	9%	2.50%	49%

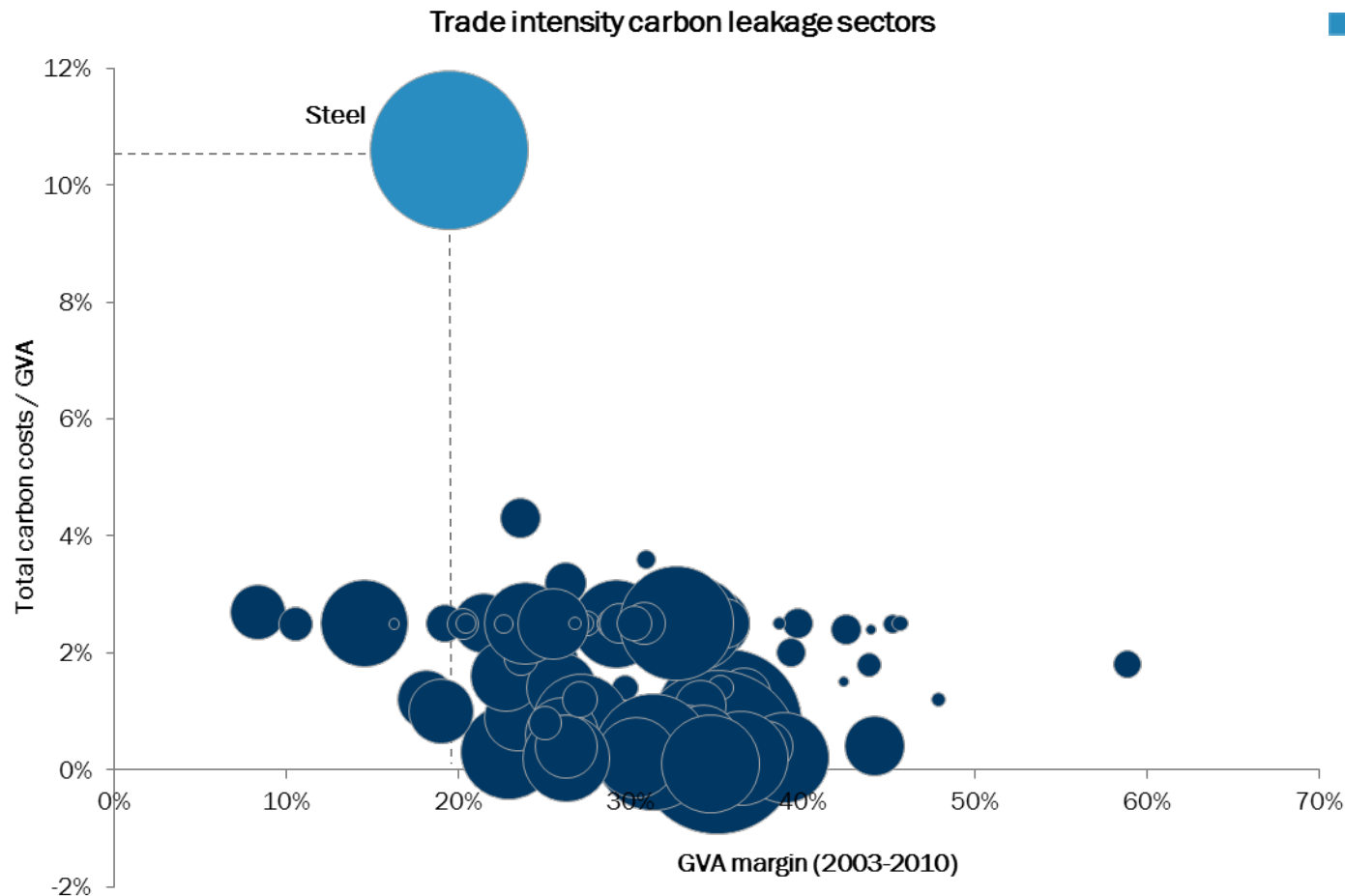
Source: EC decision (24/12/2009), Eurostat, Delft "Carbon Leakage and the Future of the EU ETS Market"

(2013), FTI Consulting analysis

Note: Total trade intensity group figures only includes 113 sectors for which information was available

*Value represents estimate from a range.

Compared to steel, these sectors have significantly lower carbon costs and significantly larger margins



■ The trade intensity sectors have significantly lower carbon costs and higher margins than the steel sector

■ The vast majority of the trade intensity sectors have higher margins than the steel sector; exceptions include crude oils and fats, precious metals production, television and radio receivers

■ The median carbon cost/GVA for the trade intensity sectors is 2.5% compared to the steel sector's 11%, i.e. the median trade intensity sector faces 23% of the steel sector's carbon costs/GVA

■ Even the most carbon intensive sector, man made fibres, has less than half of the steel sector's carbon cost as a percentage of GVA

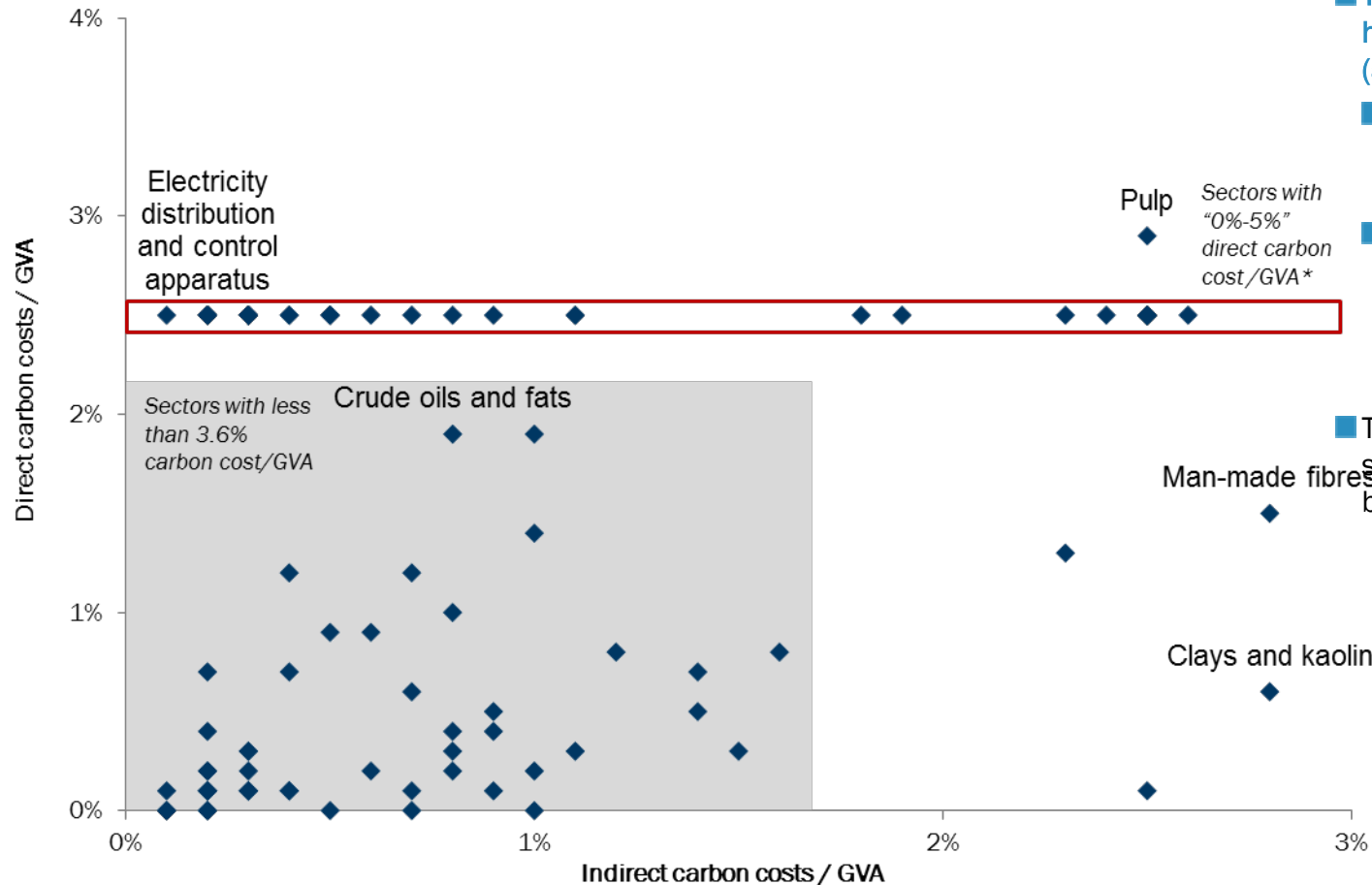
■ Applying the modelled results of the steel (or cement) sector to the trade intensity sectors would overestimate the impact of carbon costs on these sectors. **These sectors have to be treated differently from the carbon cost and the joint criteria group**

Source: Eurostat, Delft "Carbon Leakage and the Future of the EU ETS Market" (2013), FTI Consulting analysis

Note: For those sectors in which a carbon cost/GVA range was reported, a mid-range value has been used

Direct and indirect carbon intensity vary across the sectors of the trade intensity group

Trade intensity carbon leakage sectors



- The majority of trade intensity sectors have less than 3.6% carbon cost/GVA (at 75% auctioning and €30 EUA price)
- Exceptions include Pulp, Man-made fibres, Clays and kaolin and Electricity distribution and control apparatus
- Note that the Delft report presented range estimates of 0%-5% for direct carbon costs for a number of sectors. For the range estimates the mid-point 2.5% is presented here
- Total carbon costs of the trade intensity sectors appear to be equally divided between direct and indirect costs

Source: Delft "Carbon Leakage and the Future of the EU ETS Market" (2013), FTI Consulting analysis

Note: For those sectors in which a carbon cost/GVA range was reported, a mid-range value has been used.

Turnover, EBITDA and EBITDA margin for the Carbon Leakage group in scenarios modelled

Scenario (Carbon price, % auctioned)	Turnover (€ billion)	EBITDA (€ billion)	EBITDA margin
Baseline	3,288.7	340.6	10.4%
€5, 34%	3,288.8	338.4	10.3%
€5, 70%	3,289.2	337.3	10.3%
€5, 100%	3,289.7	336.5	10.2%
€20, 34%	3,290.6	332.5	10.1%
€20, 70%	3,294.7	330.0	10.0%
€20, 100%	3,297.4	327.3	9.9%
€40, 34%	3,295.3	326.5	9.9%
€40, 70%	3,300.9	320.1	9.7%
€40, 100%	3,304.2	314.3	9.5%

Source: FTI Consulting analysis

Note: Only carbon cost, joint and trade intensity sectors of Carbon Leakage group included in overall analysis.

EBITDA by Carbon Leakage group

Carbon cost group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	5.90	5.62	5.45	5.31
€20		5.04	4.38	3.83
€40		4.29	3.00	1.97

Trade intensity group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	259.51	258.72	258.33	258.01
€20		256.34	254.80	253.51
€40		253.17	250.09	247.51

Joint group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	75.19	74.02	73.53	73.21
€20		71.16	70.82	70.00
€40		69.07	67.01	64.84

Source: FTI Consulting analysis

EBITDA margin by Carbon Leakage group

Carbon cost group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	25.2%	24.0%	23.1%	22.4%
€20		21.2%	18.1%	15.6%
€40		17.6%	12.0%	7.7%

Trade intensity group

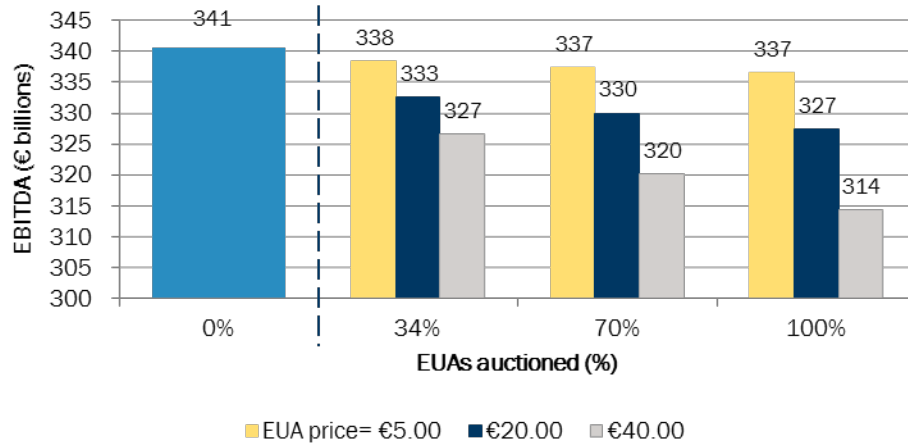
EBITDA (€ billion)	Baseline	34%	70%	100%
€5	11.6%	11.6%	11.5%	11.5%
€20		11.5%	11.4%	11.3%
€40		11.3%	11.2%	11.1%

Joint group

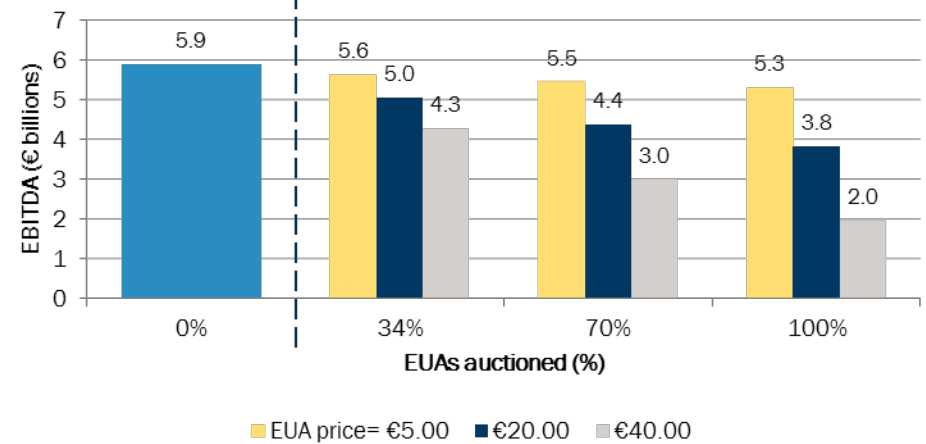
EBITDA (€ billion)	Baseline	34%	70%	100%
€5	7.3%	7.2%	7.2%	7.1%
€20		6.9%	6.9%	6.8%
€40		6.7%	6.5%	6.2%

EBITDA by major Carbon Leakage groups in the scenarios modelled

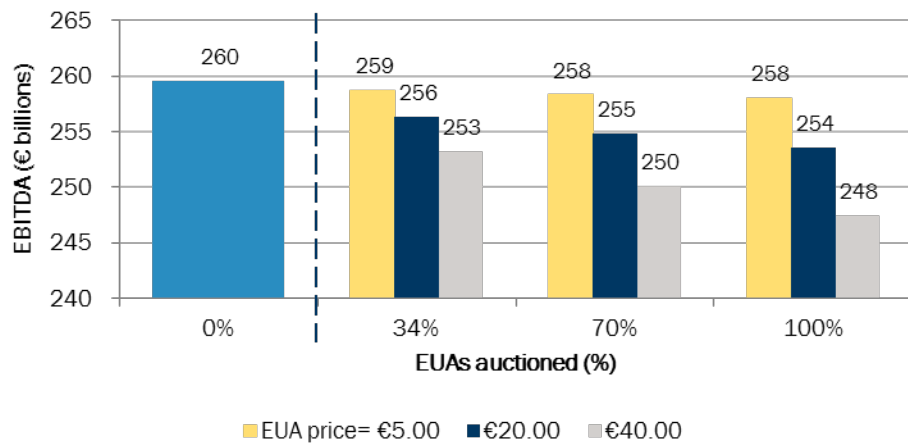
Major Carbon Leakage groups' EBITDA



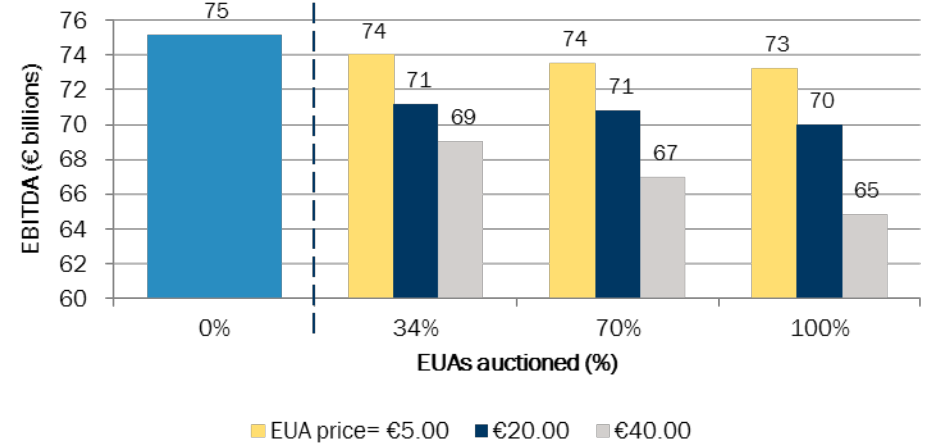
Carbon cost group's EBITDA



Trade intensity group's EBITDA



Joint group's EBITDA



Source: FTI Consulting analysis

Note: Only carbon cost, joint and trade intensity sectors of Carbon Leakage group included in overall analysis.

Change in turnover, EBITDA and EBITDA margin for the major Carbon Leakage groups in scenarios modelled

Scenario (Carbon price, % auctioned)	Change in turnover (€ billion)	Change in EBITDA (€ billion)	Percentage change in EBITDA margin
Baseline	0	0	0.0%
€5, 34%	+0.11	-2.24	-0.7%
€5, 70%	+0.51	-3.28	-1.0%
€5, 100%	+0.99	-4.06	-1.2%
€20, 34%	+1.95	-8.05	-2.4%
€20, 70%	+6.00	-10.60	-3.1%
€20, 100%	+8.66	-13.25	-3.9%
€40, 34%	+6.60	-14.07	-4.1%
€40, 70%	+12.25	-20.51	-6.0%
€40, 100%	+15.56	-26.28	-7.7%

Source: FTI Consulting analysis

Note: Only carbon cost, joint and trade intensity sectors of Carbon Leakage group included in overall analysis.

Percentage change in EBITDA margin for the major Carbon Leakage groups relative to the baseline

Carbon cost group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	0%	-4.7%	-7.6%	-10.0%
€20		-14.5%	-25.8%	-35.0%
€40		-27.4%	-49.2%	-66.7%

Trade intensity group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	0%	-0.3%	-0.5%	-0.6%
€20		-1.2%	-1.8%	-2.3%
€40		-2.4%	-3.6%	-4.6%

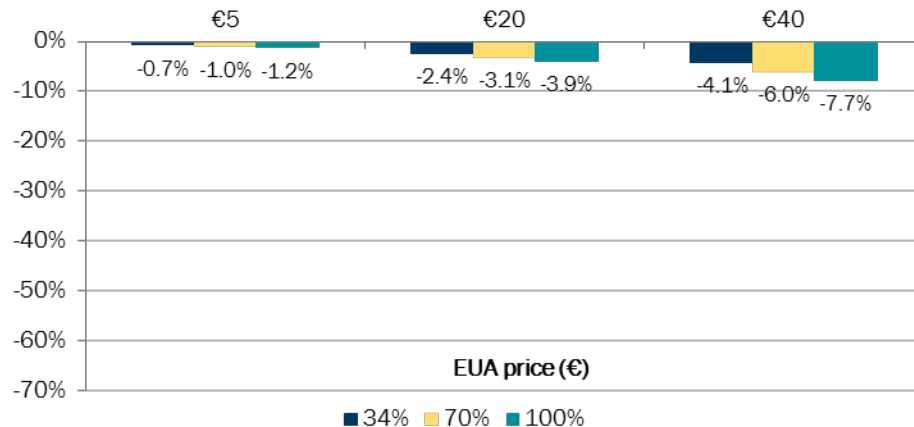
Joint group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	0%	-1.6%	-2.2%	-2.6%
€20		-5.4%	-5.8%	-6.9%
€40		-8.1%	-10.9%	-13.8%

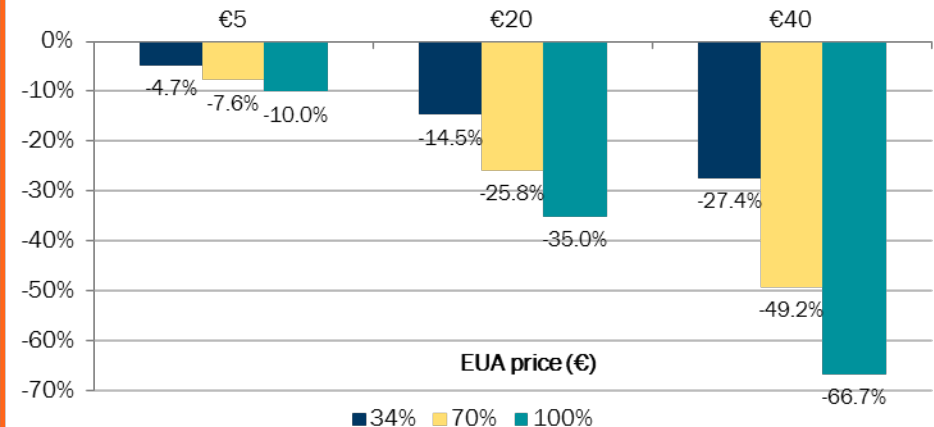
Source: FTI Consulting analysis

Percentage change in EBITDA for the major Carbon Leakage groups is still less than 8% at a modelled EUA price of €40.00, with 100% auctioning

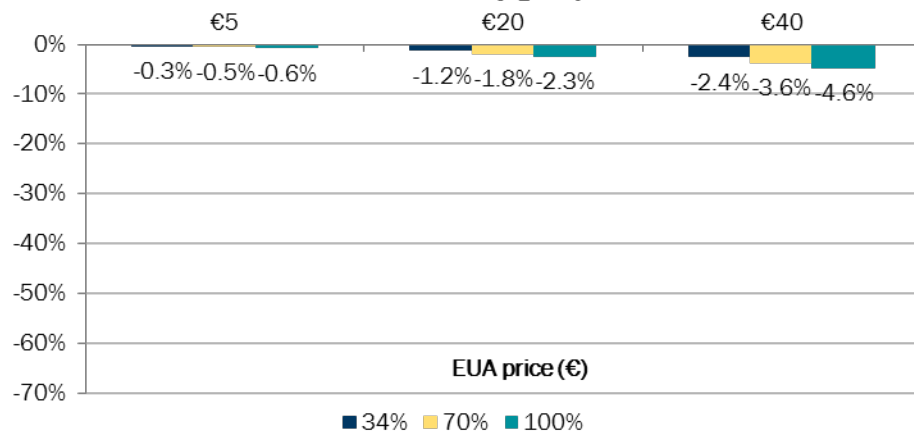
Percentage change in EBITDA relative to the baseline for major Carbon Leakage groups



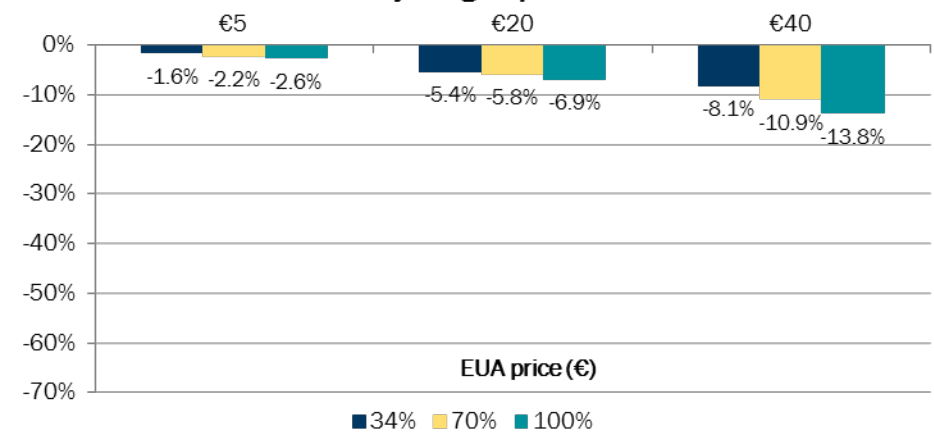
Percentage change in EBITDA relative to the baseline for carbon cost group



Percentage change in EBITDA relative to the baseline for trade intensity group



Percentage change in EBITDA relative to the baseline for joint group



Source: FTI Consulting analysis

Note: Only carbon cost, joint and trade intensity sectors of Carbon Leakage group included in overall analysis.

Employment levels for the major Carbon Leakage groups in the scenarios modelled

Scenario (Carbon price, % auctioned)	Employment	Change in employment relative to the baseline	Percentage change in employment
Baseline	14,610,168	0	0.00%
€5, 34%	14,609,536	-633	0.00%
€5, 70%	14,608,046	-2,122	-0.01%
€5, 100%	14,606,116	-4,052	-0.03%
€20, 34%	14,602,333	-7,836	-0.05%
€20, 70%	14,584,171	-25,997	-0.18%
€20, 100%	14,571,170	-38,998	-0.27%
€40, 34%	14,582,770	-27,399	-0.19%
€40, 70%	14,552,663	-57,505	-0.39%
€40, 100%	14,530,188	-79,980	-0.55%

Source: FTI Consulting analysis

Note: Only carbon cost, joint and trade intensity sectors of Carbon Leakage group included in overall analysis.

Employment level for the major Carbon Leakage groups in the scenarios modelled

Carbon cost group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	75,744	75,463	75,222	75,022
€20		74,623	73,659	72,856
€40		73,503	71,575	69,969

Trade intensity group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	12,636,136	12,636,136	12,636,136	12,636,136
€20		12,636,136	12,636,136	12,636,136
€40		12,636,136	12,636,136	12,636,136

Joint group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	1,898,289	1,897,936	1,896,688	1,894,959
€20		1,891,574	1,874,376	1,862,178
€40		1,873,131	1,844,952	1,824,083

Source: FTI Consulting analysis

Change in employment level for the major Carbon Leakage groups in the scenarios modelled

Carbon cost group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	0	-280	-521	-722
€20		-1,120	-2,084	-2,887
€40		-2,241	-4,168	-5,775

Trade intensity group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	0	0	0	0
€20		0	0	0
€40		0	0	0

Joint group

EBITDA (€ billion)	Baseline	34%	70%	100%
€5	0	-353	-1,601	-3,330
€20		-6,715	-23,913	-36,111
€40		-25,158	-53,337	-74,206

Source: FTI Consulting analysis

Detailed results of benefits of removing exemptions for carbon leakage sectors

Output and employment generated by recycling government revenues into the economy 1/2

Scenario (Carbon price, % auctioned)	Impact on economic output (€ billions)	Impact on economic output (€ per household)	Impact on employment (thousands of employees)	Impact on economic output (€ billions)	Impact on economic output (€ per household)	Impact on employment (thousands of employees)	Impact on economic output (€ billions)	Impact on economic output (€ per household)	Impact on employment (thousands of employees)
	Spent in line with existing government spending			Earmarked for R&D and clean technologies			Earmarked for the manufacturing sector		
Average (2003 – 2010)	11,570	55,909*	221,467	11,570	55,909*	221,467	11,570	55,909*	221,467
€5, 34%	2.2	10.5	35.5	3.2	15.4	32.7	3.5	17.1	44.7
€5, 70%	3.7	17.9	60.8	5.4	26.0	56.2	6.0	28.9	75.8
€5, 100%	5.0	24.3	82.5	7.2	35.0	76.3	8.0	38.8	102.4
€20, 34%	9.0	43.7	148.2	13.1	63.4	136.9	14.6	70.4	184.9
€20, 70%	15.9	76.8	260.3	22.6	109.1	241.7	24.9	120.5	320.4
€20, 100%	21.4	103.3	350.2	30.2	146.1	325.6	33.4	161.2	429.9
€40, 34%	18.9	91.5	310.2	27.1	130.9	287.5	30.0	144.9	383.6
€40, 70%	32.1	155.0	525.4	45.4	219.6	488.3	50.2	242.4	645.6
€40, 100%	42.9	207.1	702.0	60.6	292.6	652.8	66.8	322.9	861.2

Source: Eurostat, FTI Consulting analysis

*Number of EU27 households in 2009 used to calculate this figure

Note: Table indicates increase in output in each scenario using a Type 1 multiplier. These estimates are conservative as they do not include induced consumption effects. In all scenarios, we assume a 0% fall in electricity prices and that all countries provide state aid at 77.5% intensity.

Output and employment generated by recycling government revenues into the economy 2/2

Scenario (Carbon price, % auctioned)	Impact on economic output (€ billions)	Impact on economic output (€ per household)	Impact on employment (thousands of employees)	Impact on economic output (€ billions)	Impact on economic output (€ per household)	Impact on employment (thousands of employees)	Impact on economic output (€ billions)	Impact on economic output (€ per household)	Impact on employment (thousands of employees)
	Spent in line with existing government spending			Earmarked for R&D and clean technologies			Earmarked for the manufacturing sector		
Average (2003 – 2010)	11,570	55,909*	221,467	11,570	55,909*	221,467	11,570	55,909*	221,467
€5, 34%	0.02%	0.02%	0.02%	0.03%	0.03%	0.01%	0.03%	0.03%	0.02%
€5, 70%	0.03%	0.03%	0.03%	0.05%	0.05%	0.03%	0.05%	0.05%	0.03%
€5, 100%	0.04%	0.04%	0.04%	0.06%	0.06%	0.03%	0.07%	0.07%	0.05%
€20, 34%	0.08%	0.08%	0.07%	0.11%	0.11%	0.06%	0.13%	0.13%	0.08%
€20, 70%	0.14%	0.14%	0.12%	0.20%	0.20%	0.11%	0.22%	0.22%	0.14%
€20, 100%	0.18%	0.18%	0.16%	0.26%	0.26%	0.15%	0.29%	0.29%	0.19%
€40, 34%	0.16%	0.16%	0.14%	0.23%	0.23%	0.13%	0.26%	0.26%	0.17%
€40, 70%	0.28%	0.28%	0.24%	0.39%	0.39%	0.22%	0.43%	0.43%	0.29%
€40, 100%	0.37%	0.37%	0.32%	0.52%	0.52%	0.29%	0.58%	0.58%	0.39%

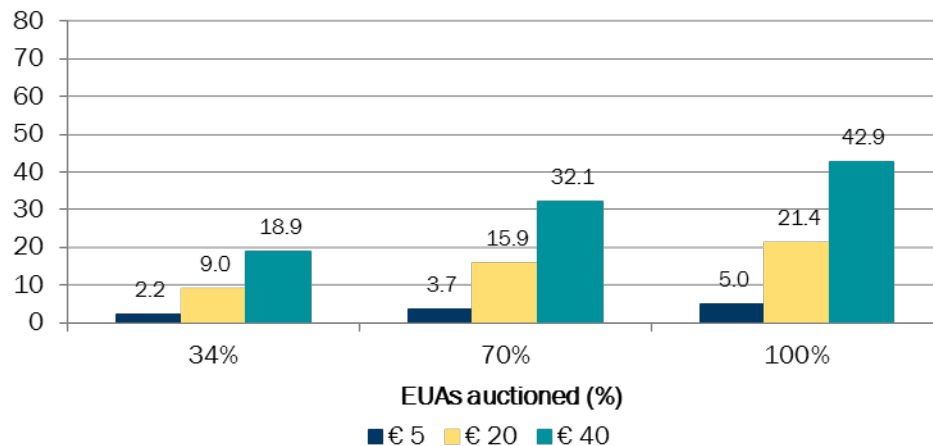
Source: Eurostat, FTI Consulting analysis

*Number of EU27 households in 2009 used to calculate this figure

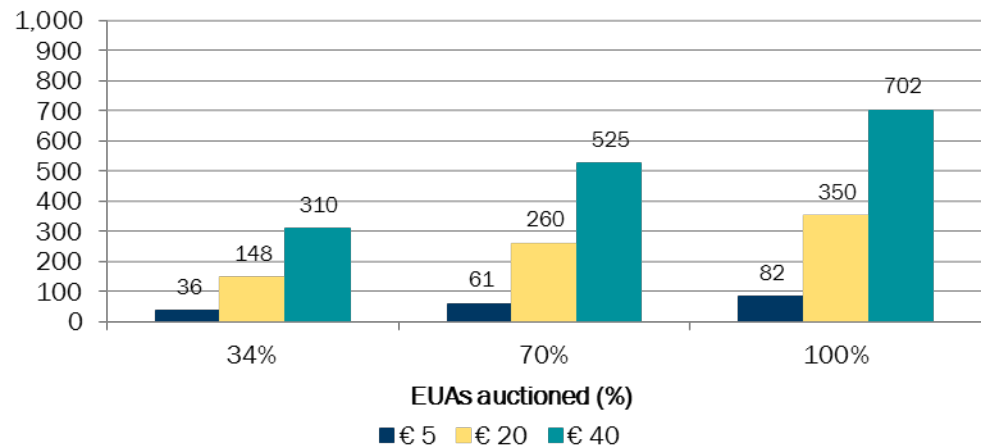
Note: Table indicates increase in output in each scenario using a Type 1 multiplier. These estimates are conservative as they do not include induced consumption effects. In all scenarios, we assume a 0% fall in electricity prices and that all countries provide state aid at 77.5% intensity.

Economic effects when additional government budget is spent in line with existing pattern of expenditure

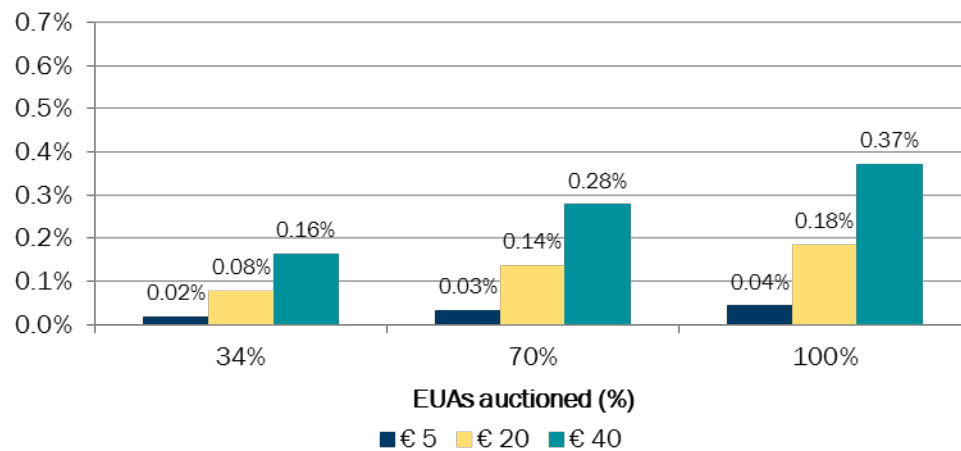
Increase in economic output (€ billions)



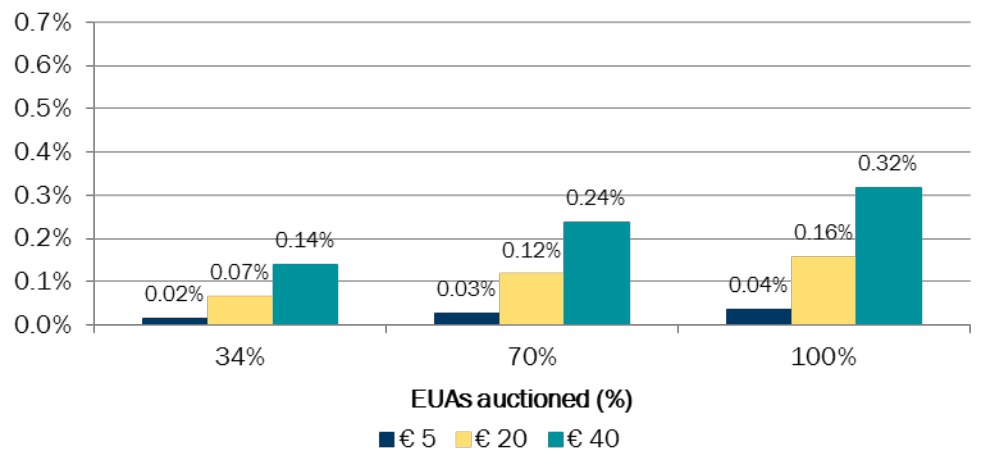
Increase in employment (000s of employees)



Increase in economic output (%)



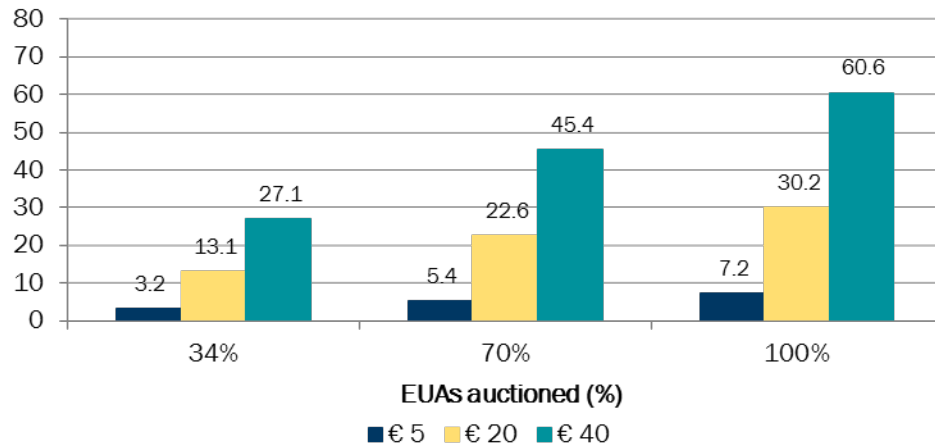
Increase in employment (%)



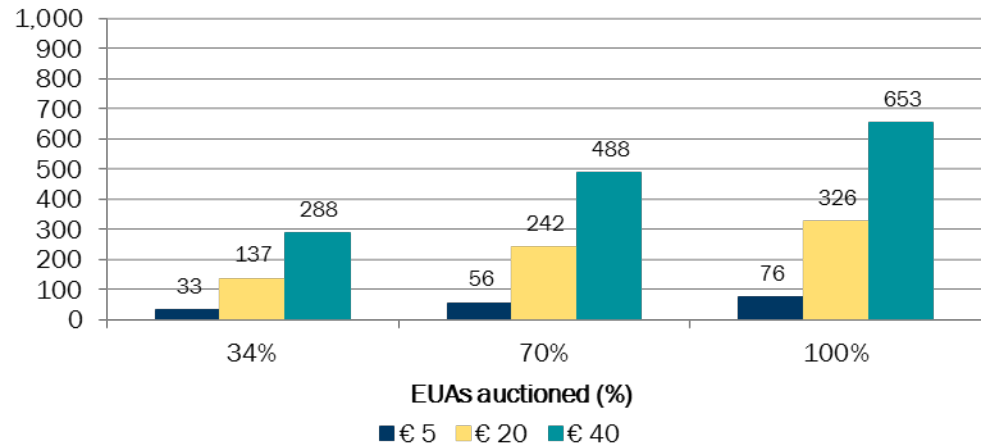
Source: FTI Consulting analysis

Economic effects when additional government budget is earmarked for R&D and clean technologies

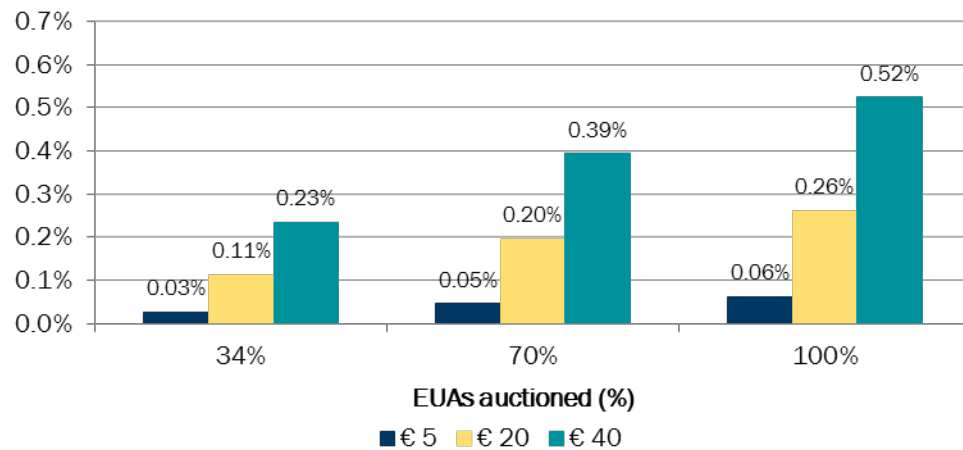
Increase in economic output (€ billions)



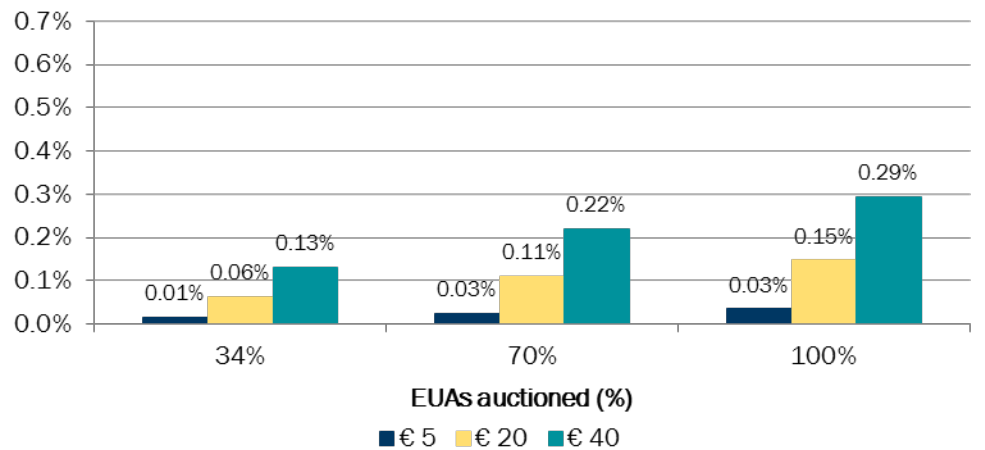
Increase in employment (000s of employees)



Increase in economic output (%)



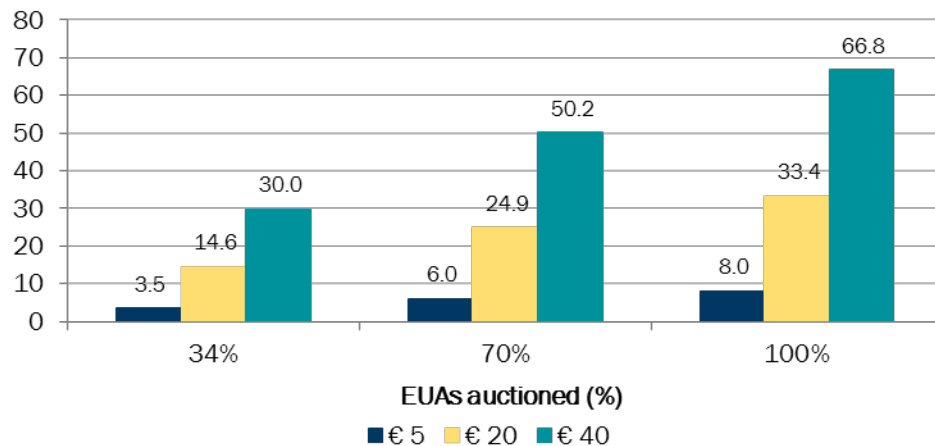
Increase in employment (%)



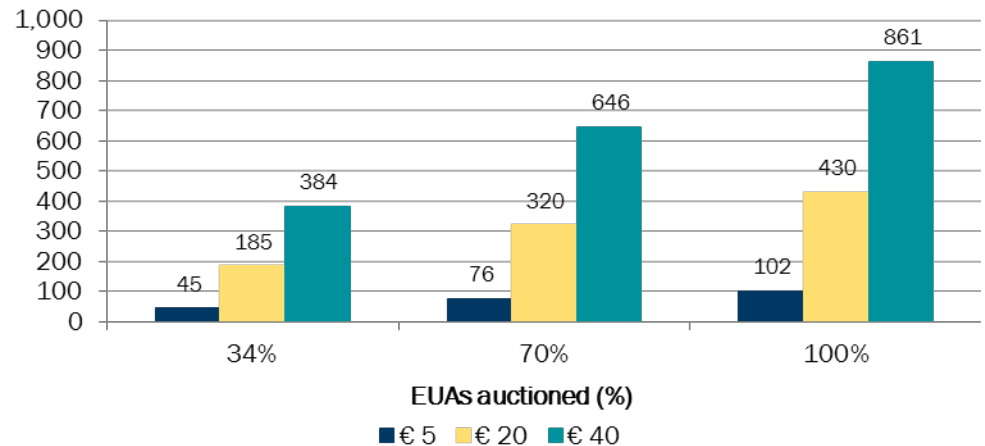
Source: FTI Consulting analysis

Economic effects when additional government budget is earmarked for the manufacturing sector

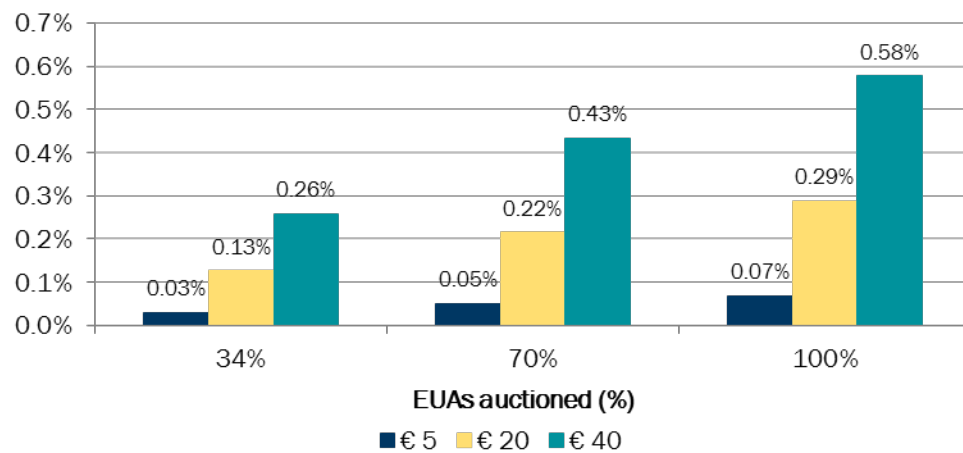
Increase in economic output (€ billions)



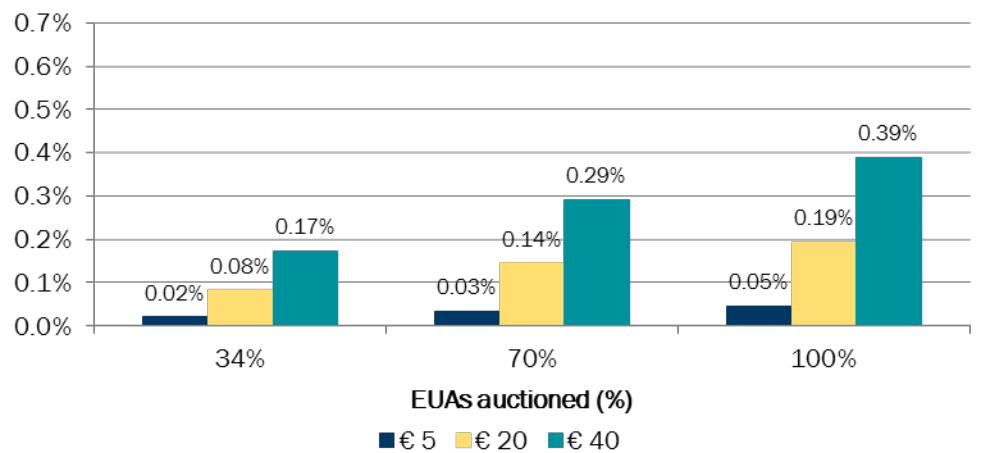
Increase in employment (000s of employees)



Increase in economic output (%)



Increase in employment (%)



Source: FTI Consulting analysis