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An Empirical Assessment of the Risk of Carbon Leakage in Poland

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ADDRESSING A RESEARCH GAP TO GO BEYOND DOGMA

Poland is a particularly carbon intensive economy. This has created concern that it may be particularly exposed to carbon leakage. However, there is an absence of robust and transparent empirical research on carbon leakage risks in Poland. This study aims at filling this gap by assessing the impact of EU climate policy, in particular the EU Emissions Trading Scheme, on Polish industry.

COST IMPACTS OF THE EU ETS

With no mitigating measures, a small number of Polish industrial sectors would face significant carbon costs. However, with free allocation, banked surplus allowances and a carbon price of €30/ton, only one sector would face direct carbon costs in excess of 5% of operating profits. Three sectors face direct carbon costs in the order of 1-3% of operating profits; three face no direct carbon costs. With direct compensation for indirect carbon costs (electricity price increases), the two most affected sectors would face indirect costs of 3.5 to 5.5% of gross value added with a carbon price of €30/ton. The vast majority of Poland's trade in energy intensive sectors occurs within the EU. It is important to maintain a harmonized climate policy to avoid internal market distortions.

UNLOCKING POLISH SUPPORT TO FUTURE CLIMATE POLICY DEVELOPMENTS

There is thus a negligible risk of carbon leakage in Poland under current policy. The mitigating measures in the EU Directive remove the vast majority of direct and indirect carbon costs for Polish industry. EU climate policy can be made more stringent without inducing risks of significant carbon leakage. The current benchmarking system appears to be reasonably effective at not structurally disadvantaging less carbon efficient Member States like Poland. And it is vital to maintaining a harmonized climate policy. Finding a harmonized way to address indirect carbon costs may unlock Polish support for future policy.

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The conclusions and any errors are those of the authors solely.

☆☆☆

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EXECUTIVE SUMMARY

This paper empirically assesses the risks of carbon leakage in Poland under the European Union Emissions Trading Scheme (EU ETS) in the short and medium term. It analyses four key questions to draw conclusions about the scale of the risks:

1. How important are energy intensive sectors to Polish economic growth and employment?
2. How carbon and energy efficient are Polish industrial sectors compared to the EU15?
3. What are the cost implications of the EU ETS for Polish industries if carbon prices rose significantly from current levels?
4. With whom does Poland trade in energy intensive goods and how intense is competition with producers from non-EU ETS countries?

1. Energy Intensive Industries in the Polish Economy

Energy intensive manufacturing sectors play a small role in the overall Polish economy, accounting for 5.1% of total gross value added (GVA). This is larger, but not significantly so, than in the EU15, where they account for 3.8% of GVA. Direct employment in these sectors has remained roughly stagnant in Poland since 2002. Recent growth in these sectors is therefore driven by productivity improvements, not increased employment. Poland is a net importer of energy intensive goods and domestic growth in these sectors has been driven by strong demand growth from downstream sectors, not by exports. Economic growth in Poland during the 2000s has been mainly driven by strong growth in the services, construction and non-energy intensive manufacturing sectors.

2. The Carbon and Energy Efficiency of Polish Industrial Sectors

Poland's industrial production is more carbon intensive than that of the EU15. This is largely due to the high share of coal in Polish electricity production. The carbon intensity of Polish electricity production is slightly higher than that of China, and more than twice as high as that of the EU15.

By contrast, Poland has made significant progress in improving the carbon intensity of its direct fuel consumption in industry, shifting from coal to natural gas and biomass. Likewise, the energy intensity of Polish industrial production has dramatically improved. Based on these two indicators, Poland's industrial sector is not substantially different from the EU15.

The carbon intensity gap between Poland and the EU15 is smaller in energy intensive industrial sectors because of recent investments in new and more carbon and energy efficient capital equipment

3. Compliance Costs of EU ETS and Leakage Risks

Direct Carbon Costs

Direct carbon costs arise from the purchase of emissions allowances to cover the emissions of the industrial facility itself. In a "hypothetical" case without free allocation of emissions permits, seven Polish industrial sectors would face mild to large direct carbon costs under a carbon price of €20/ton. Relative to operating profits, these costs range from 3.5% in the pulp and paper sector to 31% in the lime sector. This assumes that Polish facilities cannot pass-through any of these costs into their product prices and that they have no lower cost options to reduce emissions. This will not hold fully in reality.

A second "best estimate" case includes the free allocation of allowances for EU ETS Phase III and the stock of unused allowances from EU ETS Phase II. Once these are included, only the refinery sector faces a carbon cost of above 5% of operating profits, even with a carbon price of €30/ton. Three energy intensive sectors face negligible direct carbon costs in the order of 1-3% of operating profits, and three energy intensive sectors face no direct carbon costs at all.

Direct costs for the refining sector are driven by the purchase of allowances to cover emissions from on-site electricity production. Poland has the option to use direct state-aid to compensate some of these direct carbon costs arising from on-site electricity production (see *Indirect Carbon Costs*). These factors mean that the compliance costs for refineries are somewhat overestimated here.

- **When mitigating measures such as free allocation are taken into account, Polish energy intensive sectors face small to zero direct carbon costs. The risk of carbon leakage arising from direct carbon costs therefore seems negligible, even with a carbon price of €30/ton.**

Indirect Carbon Costs

Indirect carbon costs are paid by industrial facilities via the carbon cost-related increases in the electricity price. The extent of this electricity price increase is called the "pass-through rate". The pass-through rate is determined by the carbon intensity of the last generator in the electricity supply curve (the marginal generator). This tends to be more uniform across countries than the overall carbon intensity of the electricity mix. Poland's pass-through rate should be slightly higher than the EU15, but not as large as the difference in their carbon intensity of total electricity supply.

Under a "hypothetical" case with no mitigating measures, three sectors would face indirect carbon costs above 5% of sectoral gross value added (GVA) with a carbon price of €30/ton. However, Member States have the option to directly compensate electricity-intensive sectors for these indirect carbon costs. The maximum allowed compensation rate begins at 85% and falls to 75% by 2020. Auction revenues from the EU ETS provide significant new fiscal resources, part of which could be used for this state aid.

Assuming the lowest maximum allowed compensation rate of 75% and a carbon price of €30/ton, indirect carbon costs for the two most affected sectors fall to 5.5 and 3.5% of GVA. However, there is a risk that Member States may be unwilling or unable to allocate the maximum allowed state aid, particularly in a policy context of fiscal consolidation. This could potentially lead to competitiveness distortions within the EU.

- **Direct compensation is effective at reducing indirect carbon costs, even under a high carbon price and low maximum compensation rate. However, the decentralized system of optional budgetary compensation could pose risks of distortions. A harmonized system for addressing indirect costs could be a key to the next Climate and Energy Package, particularly given Poland's concerns regarding the policy's impacts on electricity prices.**

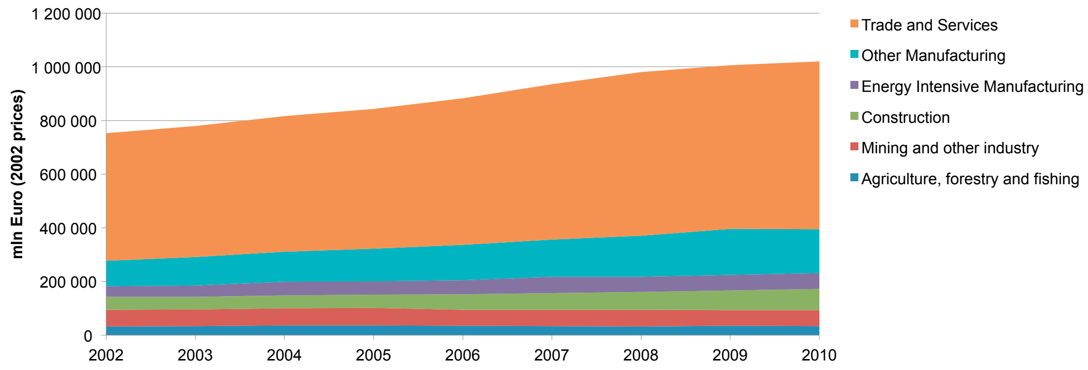
The Impact of Benchmarking

The fact that Polish energy intensive sectors would face negligible direct carbon costs at carbon prices of 20 and €30/ton reflects the fact that they are strongly compensated under the EU ETS's free-allocation mechanisms. From EU ETS Phase III free allocation is based on EU-wide emissions performance benchmarks. Under benchmarking, Poland's energy intensive industrial sectors are allocated slightly fewer free allowances (compared to historical emissions) than the EU15. But the difference is small and not uniform across all sectors. These small differences with the EU15 reflect the fact that Polish industry has made rapid improvements in energy and carbon efficiency. Poland therefore does not appear to be meaningfully disadvantaged in the internal EU market by the use of EU-wide benchmarks.

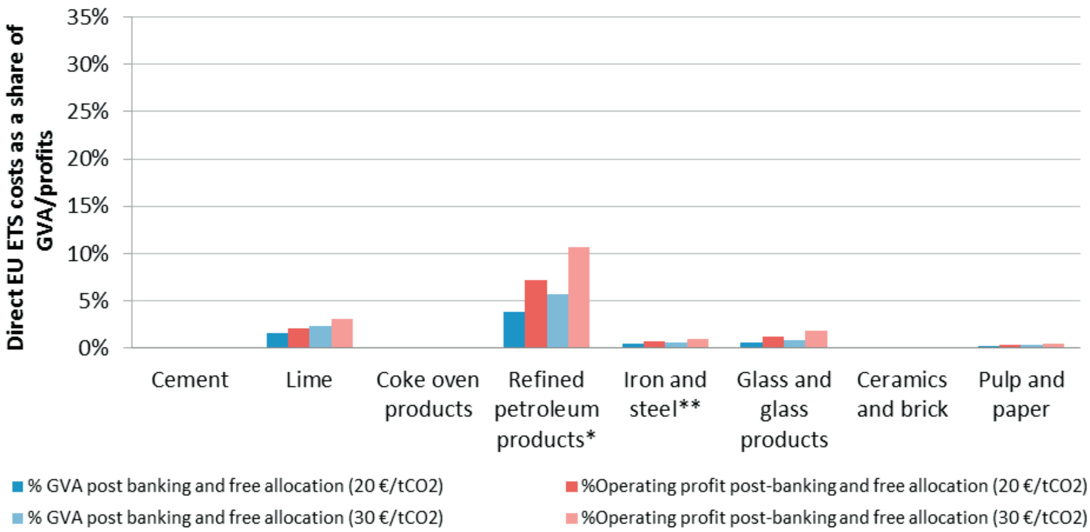
The refinery and pulp and paper sectors are the only two that receive a significantly smaller free allocation (in the order 10%). Polish facilities in these two sectors tend to produce their own their electricity and are responsible for the associated emissions. They thus pay the carbon cost of electricity directly. By contrast, facilities in the EU15 tend to buy their electricity from the grid, and the electricity generator is responsible for the associated emissions. However, EU15 facilities will ultimately pay the carbon cost of electricity indirectly via the electricity price. This difference explains why Poland is allocated less than the EU15 in these two sectors under benchmarking.

- **Under benchmarking, Poland's industrial sectors are well protected from carbon leakage risks even assuming much higher carbon prices than currently prevail in the EU carbon market. Polish industries are allocated slightly less than the EU15, but the difference is generally small and not uniform. In the two sectors with the largest difference, Polish and EU15 facilities should nonetheless pay broadly the same carbon cost, directly or indirectly.**

Executive Summary Figure 1. Real growth in Polish GVA by sector 2002-2010



Executive Summary Figure 2. Direct carbon costs after benchmarked free allocation and banking



Poland's Trade Relationships in Energy Intensive Manufacturing Sectors

Poland's energy intensive manufacturing sectors tend to have high trade intensity. However, a large majority of this trade occurs with other EU countries. The average EU share in Poland's total trade in thirteen key industrial sectors is 79%. Overall, Poland does not seem to trade more intensively with nearby non-EU countries like Russia and Ukraine, with the exception of the pulp and paper and rubber sectors.

The high EU trade intensity is due to both formal and informal barriers to trade and thus entry into the EU market by third countries. These barriers to trade for countries outside the single market provide some protection against carbon leakage, but the overall effect is difficult to quantify.

- **Poland's trade in energy-intensive sectors is largely within the EU, reflecting the advantages of being in the single market. The high intra-EU trade intensity in energy intensive sectors also underscores the importance of harmonized climate policies, in order to prevent distortions of the single market.**

Conclusions

Overall, the results suggest that there is a negligible risk of carbon leakage in Poland under current policy settings. The mitigating measures provided for in the EU Directive are effective at removing the vast majority of direct and indirect carbon costs for Polish industry, even with carbon prices of up to €30/ton, well in excess of current prices.

Looking forward, the results suggest that, firstly, EU climate policy can be made more stringent without inducing risks of significant carbon leakage. The current benchmarking system appears to be reasonably effective at providing a level playing field while not structurally disadvantaging less carbon efficient Member States like Poland. Secondly, it seems vital to maintain a harmonized climate policy for the industrial and electricity sector. Without this, the internal market would be exposed to unacceptable risks of distortion. Finding a harmonized mechanism to deal with indirect carbon costs may be a key to unlocking Polish support to future policy developments.

1. INTRODUCTION

Differences in the stringency of climate policy between countries create concerns about "carbon leakage".[1] The European Union (EU) has imposed explicit carbon pricing under the EU Emissions Trading Scheme (EU ETS). Although most major economies have adopted emissions objectives in the context of domestic policy and the global negotiations, these vary in stringency and the policies used to implement them (Jotzo, 2010).

Poland is a particularly carbon intensive economy in comparison with other EU and OECD countries. Industry also plays an important role in the Polish economy. This has created concern in Poland that it may be particularly exposed to carbon leakage. There has been a small number of studies which assess, using different methodologies, the impact of climate policy on Polish industry, and on energy intensive trade exposed sectors (EITE) in particular (Żmijewski, 2011; Bukowski, 2011; World Bank, 2011). However, there is an absence of robust and transparent empirical research on carbon leakage risks in Poland.

This study aims to go some way to filling this gap. The study assesses the two key variables for carbon leakage:

- *The cost of compliance with the EU ETS by industrial sector as a share of gross value added and operating profits within the sector*. This measures the significance of carbon pricing as a cost factor for industry, and hence the likelihood that carbon prices could realistically be a factor of comparative advantage in the given industrial sector. The study uses a robust and transparent methodology to model as closely as possible the conditions under of the EU ETS, taking into account existing measures to mitigate leakage risks.
- *Barriers to trade that may allow significant carbon prices differences to persist between regions without impacting on the geographical location of economic activity.* For this the study takes as a proxy variable the trade intensity of the given sector: low trade intensity would indicate significant barriers to trade such as transport costs.

The paper is structured as follows. Section two provides an overview of the macro-economic and energy sector context in Poland, and compares this with the EU15. Section three assesses quantitatively the importance of explicit carbon pricing for Polish industry under EU ETS Phase III, and assesses the trade exposure of Polish industry, and EITE industries in particular. Section four provides conclusions.

2. ECONOMIC AND ENERGY SECTOR CONTEXT IN POLAND

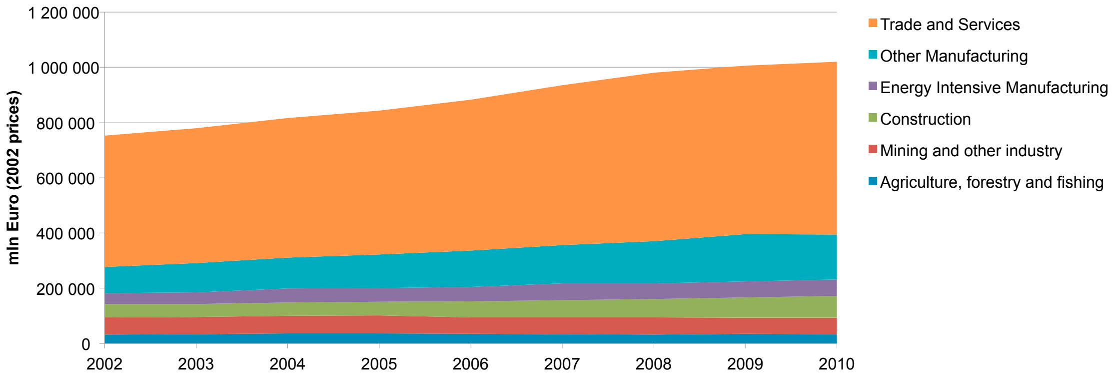
2.1 Economic Context

Poland is the 8th largest and fastest growing economy in the EU.[2] In 2011, its GDP per capita at market prices was 67% of the EU average. Between 2004 and 2012 its real growth rate averaged 4.3%.

1. Carbon leakage can be defined as the geographical shift of economic activity due to the competitiveness impacts of the different stringency of climate policies in two jurisdictions.

2. Eurostat data, at market prices.

Figure 1. Real Polish GVA by sector, 2002-2010



Source: Own calculation, Eurostat data.

Manufacturing plays an important role in the Polish economy, making up 21.8% of Polish Gross Value Added (GVA), compared to 15% in the EU15. However, the difference in the share of energy intensive manufacturing in total GVA is smaller: 5.1% in Poland compared to 3.8% in the EU15.[3] Figure 1 presents the share of energy intensive manufacturing in the overall Polish economy since 2002. GVA has been converted into constant 2002 prices using the producer price index by sector, in order to remove the effects of inflation.

The "other manufacturing" sector has experienced the fastest growth in Polish GVA, followed by the energy intensive manufacturing sectors and the construction sector. Trade and services has also experienced strong growth.[4] The primary sectors, namely agriculture and mining and quarrying, have been roughly stagnant. It can be seen that, due to its small size relative to the overall economy, the energy intensive manufacturing sector has provided a smaller absolute contribution to growth. The larger "other manufacturing" sector and the service sectors have provided large absolute contributions to growth. In sum: although energy intensive manufacturing has grown fast, its overall contribution to Polish economic activity is small.

Figure 2 compares the share of manufacturing subsectors in total GVA between Poland and the EU15. It shows that some energy-intensive manufacturing subsectors do make up a larger share of Poland's overall economic activity than in the EU15, but that this difference is relatively small—less than half a percentage point in all cases except non-metallic minerals. Two energy-intensive sectors, basic metals and chemicals and chemical products, form a more significant share of the total economy in the EU15 than in Poland.

A similar picture emerges looking at the share of manufacturing sectors in total employment. Figure 3 presents the share of manufacturing subsectors in total employment in Poland compared to the EU15. With the exception of non-metallic minerals, energy intensive manufacturing sectors are not significantly larger employers in Poland compared to the EU15.

Despite the strong rate of growth, direct employment in the energy-intensive manufacturing sectors has been roughly stagnant since 2004. This suggests that growth is being driven by increased productivity, rather than increased employment inputs. The strongest direct contribution to employment growth has come from the construction sector, followed by the service sectors. Other manufacturing, other industries, and the mining sector have been roughly stagnant in terms of employment; agriculture has declined as an employer since 2004.

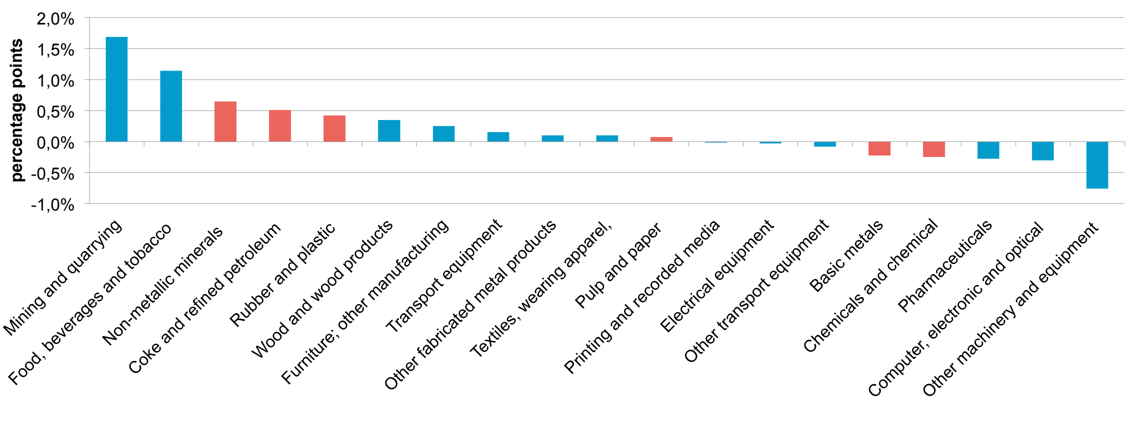
2.2 Energy in the Polish Macroeconomy and Industry

Poland's energy sector is unique in the large share of coal in electricity and heat production. In 2011, coal occupied the following shares in the Polish energy mix, in comparison with the EU15 (IEA data):

- 54% of total primary energy supply in Poland vs. 13.1% in the EU15.
- 87% of electricity production vs. 22.5% in the EU15.

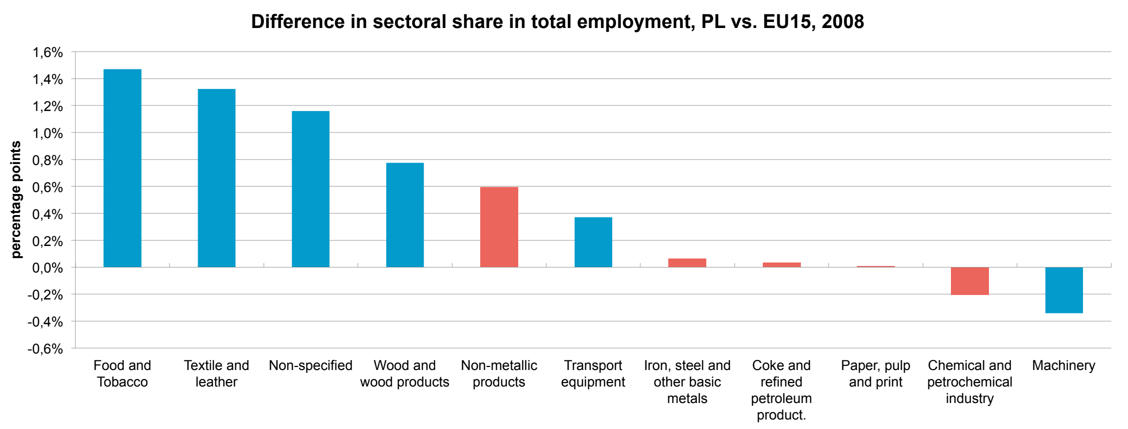
3. These are: pulp and paper, coke and refined petroleum products, chemicals, rubber and plastics, other non-metallic minerals, basic metals.
4. These are: wholesale and retail trade, transport, accommodation and food service activities; Information and communication; Financial and insurance activities; Real estate activities; Professional, scientific and technical activities; administrative and support service activities; Public administration, defence, education, human health and social work activities; Arts, entertainment and recreation & Other

Figure 2. Share of manufacturing subsectors in total GVA, Poland vs. EU15, 2008, percentage point difference



Source: Own calculation, Eurostat data.

Figure 3. Employment in manufacturing subsectors as a share in overall employment, Poland vs. EU15, percentage point difference



Source: Own calculation, Eurostat data.

- 86.7% of heat production vs. 18.9% in the EU15.

This gives Poland a high carbon intensity of GDP, and of electricity production in particular. The carbon intensity of electricity in Poland is 781 grams of CO_2/kWh (higher than that of China at 766 grams/kWh), compared to the EU15 median of 360 grams/kWh (IEA data). Figure 4 presents some key comparisons in terms of the emissions and energy intensity of Polish economic activity verses the EU15. Carbon intensity of economic activity is equal to the energy intensity of GDP, times the carbon intensity of total energy supply.

Figure 4 shows that improvements in the energy intensity of GDP have been much more significant than improvements in the carbon intensity of energy supply. Therefore the reduction in the carbon intensity of Polish GDP has mainly been driven by improvements in the energy intensity of GDP.

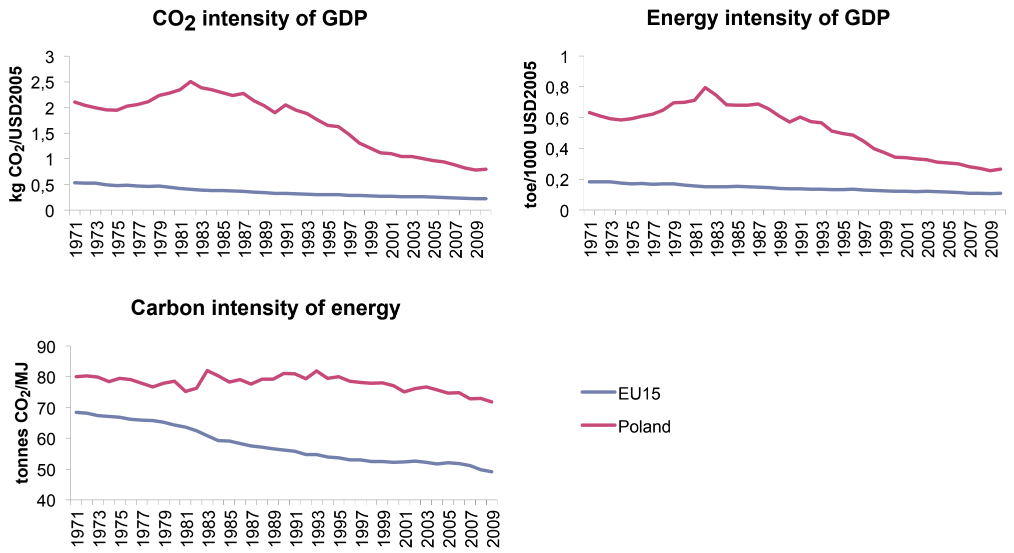
However, for the purposes of assessing carbon leakage risks, it is necessary also to zoom in on the industry sector.

Figure 5 compares the CO_2 and energy intensity of industrial value added in Poland and the EU15, and the CO_2 intensity of final energy consumption in industry. In makes the distinction between:

- *Direct CO_2 intensity*: the CO_2 intensity of energy supply from fuels for final energy consumption in industry (fossil fuels and biomass);
- *Indirect and direct CO_2 intensity*: the CO_2 intensity of energy supply from fuels *and* electricity for final energy consumption in industry. This therefore includes within the perimeter of "industry" the emissions from the production of electricity which is consumed in industry.

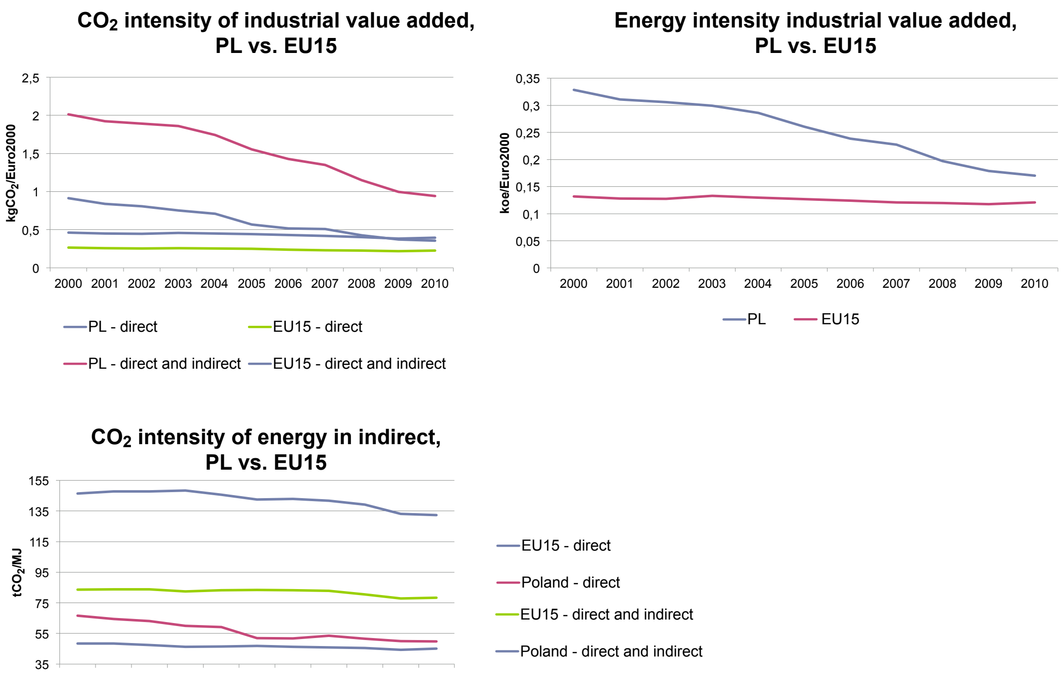
As can be seen, Poland has made impressive strides in reducing the direct CO_2 intensity of industry. However, it is useful to break this down

Figure 4. CO_2 intensity of GDP, energy intensity of GDP, carbon intensity of energy, Poland vs. EU15, 1971-2010



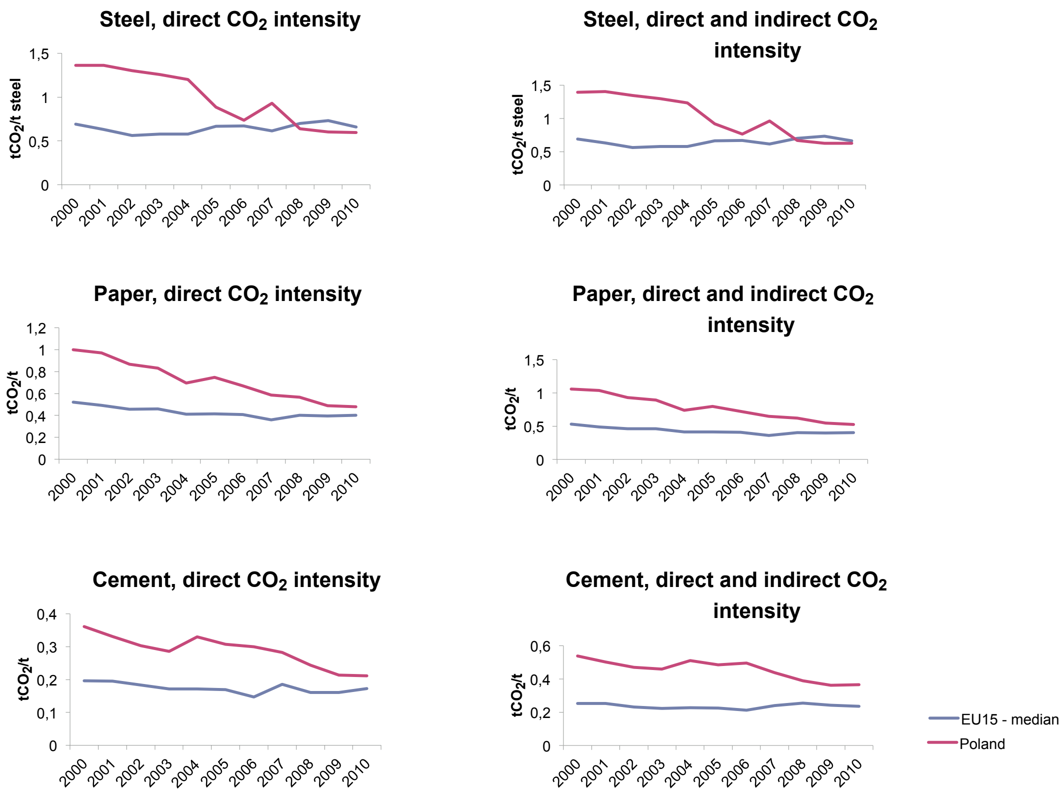
Source: Own calculation, IEA data.

Figure 5. Direct and indirect CO_2 intensity of industry, energy intensity of industry, direct and indirect CO_2 intensity of energy consumption in industry, PL vs. EU15, 2000-2010



Source: Own calculation, ODYSSEE database.

Figure 6. Direct and indirect CO2 intensity of energy intensive industrial subsectors, Poland vs. EU15, 2000-2010



Source: Own calculation, ODYSSEE database.

into improvements in energy intensity and carbon intensity of energy supply. Figure 5 shows that the carbon exposure of Polish industry has fallen significantly over the past decade:

- the *carbon intensity of industrial value added* has declined;
- this has been due to improvements in the *energy intensity of industrial value added;*
- and also a reduction in the *direct CO_2 intensity of energy supply in industry*, i.e. a shift away from coal to gas and biomass;
- The *indirect carbon intensity of energy* (i.e. electricity supply) has not improved significantly.

Therefore the largest difference in the carbon intensity of industrial production between the EU15 and Poland arises from the carbon intensity of electricity consumed in industry in Poland, when both direct and indirect emissions are considered.

It should be noted that the electricity sector in Poland will receive a transitional free allocation from Phase III of the EU ETS (2013-2020) and that direct compensation for electricity intensive industries is envisaged in the ETS Directive. These measures are intended to mitigate the carbon exposure of Polish industry arising from the carbon intensity of Polish electricity production. In the following section we quantitatively assess their efficacy in doing so.

However, for the purposes of assessing leakage risks, the analysis should also zoom in on EITE subsectors within industry. Figure 6 compares the direct and indirect CO_2 intensity of three EITE sectors for which data were available. Two caveats should be mentioned regarding the data. Firstly, we use the ODYSSEE CO_2 intensity index, which is available for all EU27 Member States. It is therefore not possible to reconstruct the index from raw CO_2 emissions and sectoral production data for the whole of EU15. We therefore take the EU15 median as the comparison. Secondly, the index is in physical not monetary terms, i.e. tCO_2/t product. This therefore removes differences arising from countries' different positions in the value chain within one manufacturing subsector. It expresses technical CO_2 intensity.

Figure 6 shows that the selected EITE sectors in Poland have also made significant improvements in both direct and indirect CO_2 intensity relative to the EU15 median. The Polish steel sector is more CO_2 efficient than that of the EU15 median country, in both direct and indirect terms. In 2010, the Polish paper sector was 19.5% more CO_2 intensive than the EU15 median; 30% more intensive if indirect emissions are also included. In the cement sector, the difference was slightly larger: 22% for direct emissions, and 55.3% higher for direct and indirect emissions.

The Poland-EU15 difference in direct and indirect CO_2 intensity in the selected EITE sectors is therefore smaller than the difference in industry overall. There may be a number of reasons for this. Firstly, for these industries energy is a key input. Energy intensive industries therefore have strong incentives to optimize energy and carbon costs, i.e. a high price elasticity. They also tend to be large installations, and therefore less susceptible to market failures such as high transaction costs and conflicting incentives between multiple actors. In addition, Poland has seen significant new investments in these sectors during the transition to a market economy and recent fast economic growth. EITE sectors are also dominated by large, multinational firms. It seems logical therefore that Poland's new capital stock in EITE sectors would be modern and close to international benchmarks.

2.3. Summary

This section has shown that EITE sectors do not play a dramatically larger role in the Polish economy than in the EU15. Poland has also made significant progress in reducing the carbon intensity of its industrial production. The higher carbon intensity of electricity constitutes the central difference between Poland and the EU15. Poland's EITE sectors are even closer to the EU15 in terms of carbon intensity, which appears logical in sectors with new capital stock, international technologies and production processes, and a high price elasticity.

3. DIRECT AND INDIRECT CARBON COSTS FOR POLISH INDUSTRY UNDER THE EU ETS

The EU ETS currently places a price on the carbon emissions of large industrial installations in Poland and 29 other European countries.[5] This section estimates of both the direct and indirect costs of the EU ETS for Polish industries at carbon prices of 20 to 30€/ton:

- *Direct carbon costs* are the cost of compliance with the Scheme for an installation owner, i.e. the cost of purchasing allowances to match its on-site verified emissions each year.
- *Indirect carbon costs* refer to costs which installations may face because electricity markets can often pass-through the cost of their own emissions allowances into the electricity price paid by industrial consumers.

In each case for direct and indirect carbon costs the assessment proceeds in two steps:

1. Firstly, a *hypothetical* case is constructed without any mitigating measures to reduce the impact of carbon pricing, such as free allocation or state-aid compensation.
2. Secondly, a *best estimate* case is constructed taking into account free allocation, state aid compensation, and the surplus of banked allowances.

This allows us to build up a detailed picture of the compliance costs faced by Polish industry in Phase III of the EU ETS. As mentioned in the introduction, the magnitude of such costs relative to variables such as profit margins is a key factor in determining the risk of carbon leakage. However, costs are not everything. A significant carbon cost difference between EU ETS and foreign non-EU ETS producers will not necessary equate to carbon leakage. A range of other factors could still mitigate leakage despite carbon cost differences between countries:

- *Other cost related factors*: transport costs, tariffs, exchange rate, other cost differences
- *Non-cost related factors*: differences in product quality, security and flexibility of supply chains, advantages of proximity to final markets, border effects (see section 3.3.3)

Annex "Costs and Other Sources of comparative Advantage" gives more detail regarding these factors that can mitigate the impacts of differences in carbon costs on comparative advantage.

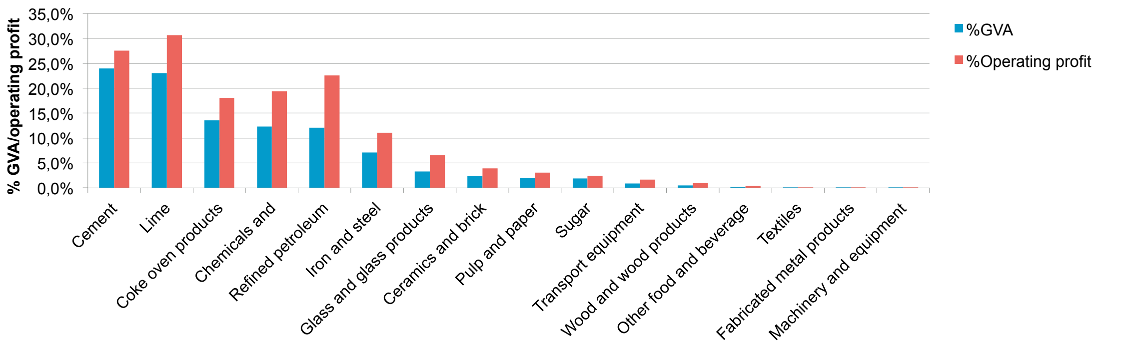
3.1. Direct Carbon Costs

3.1.1. Hypothetical Case without Mitigating Measures

To gauge the potential importance of direct carbon costs to Polish industry and the implications

5. The EU ETS presently covers emissions from combustion installations in all sectors with a thermal rated input > 20MW, as well as all large iron and steel, cement, lime, glass, mineral wool, ceramics, pulp and paper, bulk organic chemicals installations. It operates in the EU27 plus the 3 non-EU EEA countries (Norway, Iceland and Liechtenstein). Croatia will join as part of its accession to the EU, while Switzerland and Australia are presently negotiating a direct linking of their carbon markets with the EU ETS during Phase 3.

Figure 7. Direct EU ETS emissions costs, hypothetical case (% of GVA and operating profits)



Percentages are calculated using 2008 verified emissions data for each sector, and 2008 GVA and operating profit data from Eurostat' SBS database.

*Chemicals are pharmaceuticals emissions are calculated based on IEA and UNFCCC data and not CITL data. The non-ferrous metal sector is not included here as its direct emissions were not included in the EU ETS in Phase 2

thereof for carbon leakage, it is instructive to begin by calculating these costs while assuming no free allocation of allowances.

Figure 7 shows this calculation. It shows the cost of compliance with a 20€ carbon price under the EU ETS, as a share of sector gross value added and operating profits, *assuming sectors had to buy 100% of their emissions*. It also assumes that sectors do not pass-through any of the carbon price to purchasers and have no cheaper abatement options at these CO_2 prices.

6-8 key manufacturing sub-sectors can be identified which would face medium to large direct cost increases, ranging from roughly 3.5% (pulp and paper) to 31% (lime) of operating profits and 2.5% to 24% of GVA. Together these sectors account for approximately 5% of total Polish GVA.

The results presented in Figure 7 should not be interpreted simplistically as implying that these 6-8 strongly affected sectors would immediately relocate all of their production in the absence of any free allocation. Annex details some of the other factors which could mitigate leakage risks even in the presence of production cost differences. Therefore a more accurate interpretation is that, in the absence of any free allocation, the identified sectors would be realistic candidates for some degree of carbon leakage, depending on the extent of such mitigating factors at play in each sector.

3.1.2. Best Estimate Case with Benchmarked Free Allocation

In reality, however, EITE sectors will receive free allocations to shield them from the full impact of carbon cost increases. Under Article 10c of the EU's revised Emissions Trading Directive, non-electricity sectors will continue to be allocated free allowances in the future. From Phase III (2013-2020) of the EU ETS these allocations will be based on best-available technology benchmarks for the first time (EC, 2009a).

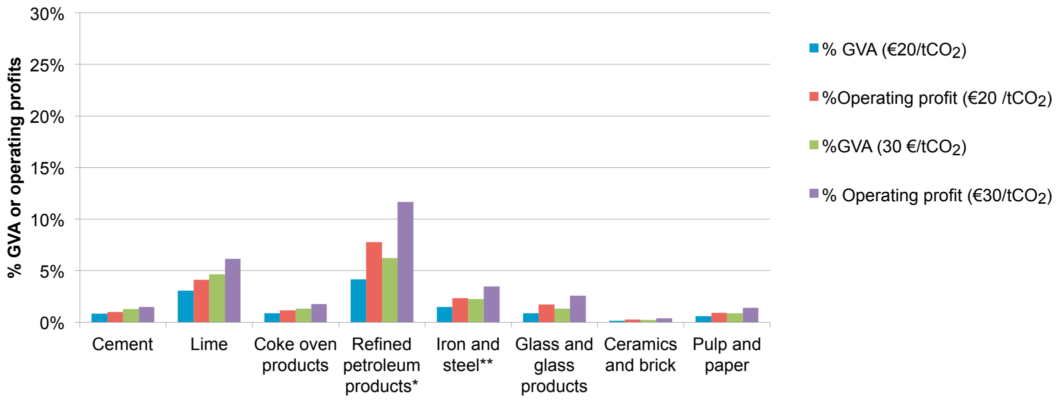
Taking free allocation into account significantly reduces the compliance cost of the EU ETS for Polish energy-intensive industries. Figure 8 illustrates this. It shows the same calculation of direct carbon costs presented in the preceding section for carbon prices of both 20 and 30 €/tCO_2. However, this time the share of historical emissions per sector that are freely allocated under benchmarking is subtracted from the cost calculation.

"Historical emissions" are defined as the year used by each individual installation in the given sector to determine its "historical activity level" used for determining free allocations under Benchmarking. This measure of emissions is taken because it is the best available measure of emission levels when plants are running at, or close to, full operating capacity. It thus avoids the temporary effects of the economic downturn. Note that growth in operating capacity over time is also eligible for further compensation (beyond a 15% threshold), so that Poland's higher economic growth rate does not necessarily matter for this calculation.

Data on Phase III free allocations comes from the National Implementing Measure (NIM) of Poland.[6] Once again it is assumed there is no CO2 price pass-through to customers, and no cost-rational abatement options at these CO_2 prices. It is also assumed that there is no banking of allowances from Phase II. This assumption is relaxed in the next sub-section. However, modelling no banking and a CO2 price of 30€/tCO_2 gives a picture of a possible

6. N.B. National implementing measures had not been formally approved by the Commission at the time of writing. Nor had the cross-sectoral adjustment factor for free allocation been determined. However, we do not believe that these will greatly influence the results.

Figure 8. Direct EU ETS costs after benchmark-based free allocation



* "Refined petroleum products" includes two large installations classified in the NIM as electricity generators but also identified by DG Enterprise as belonging to the refining sector.

**The iron and steel sector is actually over-allocated allowances for its direct emissions in compared to its historical emissions to account for waste gases that are transported to power-generators or other sites and emitted there. We therefore use information from Eurofer to assume an allocation rate of 79% of all emissions (including waste gases) for Poland.

scenario for IV of the EU ETS, i.e. after 2020. At this point, it could be expected that banked allowances will have been used up and CO2 prices will be significantly higher than currently. It can be seen that even under this scenario Polish industries face only mild direct carbon costs.

The comparison of figure 7 and figure 8 shows that after free allocation the residual compliance cost falls significantly.[7] The most cost-affected sectors become refined petrol products and lime production. For lime production even with the 30 €/tCO_2 scenario, compliance costs would be roughly 6% of operating margins and 5% of GVA. Moreover, section 4 shows that lime and cement producers should have at least some scope for carbon price pass-through to customers, since significant cost-barriers exist to trade of these goods.

For refined petroleum products, ETS compliance costs fall to 11.5% of operating margins and 6% of GVA. In part this result reflects the fact that gross operating margins are somewhat tighter in this sector than GVA. However, it also reflects the fact that the emissions perimeter of this sector also includes two large electricity production facilities. Installations in certain sectors, such as refining and pulp and paper, tend to auto-produce electricity on-site as an input into production. Typically, part of this electricity is consumed on site, while the remainder is often exported to the grid or sold to other consumers of electricity. As electricity producers must purchase 100% of their emissions allowances at auction in Phase III, the inclusion of these two installations within "refined petroleum products" significantly lowers the aggregate allocation rate for the sector as a whole and thus increases its apparent compliance costs. If these two electricity production installations are excluded from the perimeter of "refined petroleum products", the sector will actually be allocated more allowances in Phase III than its historical emissions. Its compliance costs would therefore be close to 0 % of GVA and operating profit.

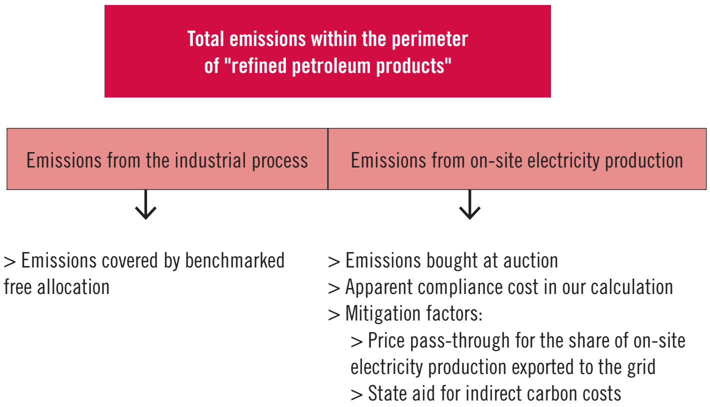
Several factors should mitigate the costs of refiners paying for allowances for the emissions of onsite electricity production. For the share of electricity exported to the grid, they would be able to pass-through the carbon price. Some refinery activities are eligible for state aid to compensate indirect carbon costs in electricity intensive industries.

Figure 9 represents schematically this problematic of the inclusion of the emissions from the auto-production of electricity within the perimeter of an industrial sector, and the difficulty this raises in terms of estimating the compliance costs of the given sector.

In summary: after taking free allocation into account, carbon prices of €20 and €30/tCO_2 are found to have only a small impact on margins, even when assuming no price-pass-through, no abatement alternatives below these carbon prices and no use of banked of allowances from Phase II. The relatively low impact of ETS compliance costs on Polish industry under Benchmarking reflects the fact that Polish installations will be allocated

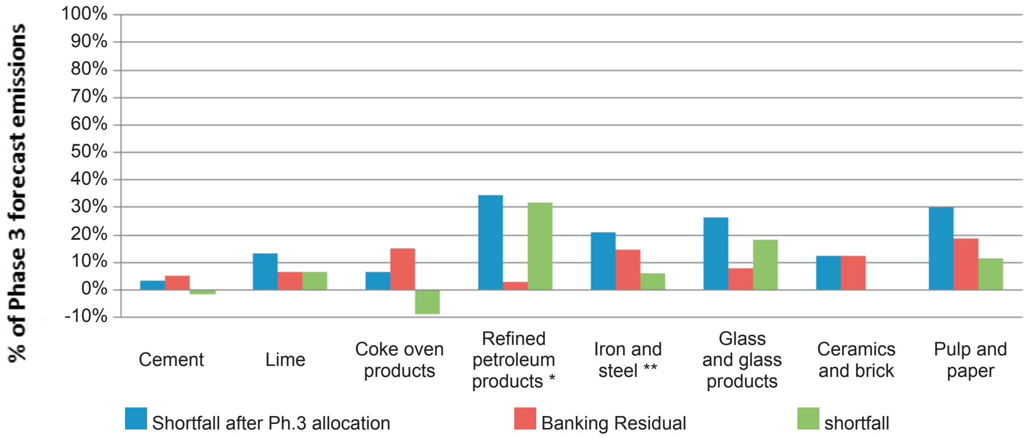
7. Chemicals and petro-chemicals is not included in the calculation since the perimeter of activities covered by the EU ETS in Phase 3 differs significantly from the activities covered in Phase 2. Hence, reliable estimates of the share of historical emissions likely to be compensated by free allocations were unobtainable.

Figure 9. Schematic representation of the inclusion of auto-produced electricity in the sector perimeter and implications for compliance cost calculation



Source: Authors.

Figure 10. Impact of banked allowances from Phase II on allowance short-fall in Phase III



Source: Authors, EUTL.

*Includes electricity generation **Assumes under-allocation of 21% after accounting for waste-gases

the vast majority of their allowances for free during EU ETS Phase III. The benchmark-based free allocation mechanism thus appears to mitigate the large majority of direct carbon cost differences between Poland and non-EU ETS countries and therefore the associated carbon leakage risk.

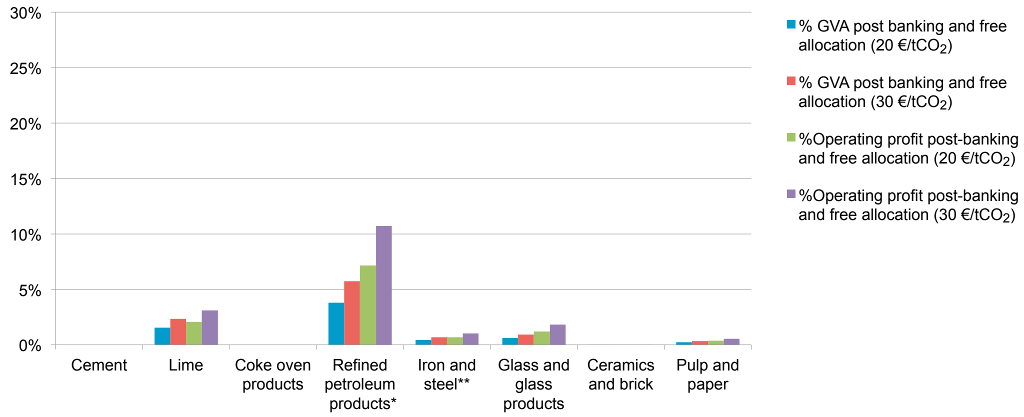
3.1.3 Best Estimate Case with Benchmarked Free Allocation and Banked Allowances

The combination of initial over-allocation and the economic crisis has allowed installations to build up significant stocks of surplus allowances during Phase II. These can be banked and used for compliance in Phase III. They should therefore be included in the analysis of Phase III compliance costs for Polish EITE sectors.

Figure 10 shows the shortfall of emissions allowances that Polish industrial sectors will face in EU ETS Phase III after taking into account benchmarked free allocation and an estimation of the stock of unused allowances from EU ETS Phase II. The latter is calculated as the difference between verified emissions and allocated allowances for each Polish EITE sector in Phase II.

In all EITE sectors the additional carry-over of allowances would reduce their Phase III compliance shortfall. On average, the 8 analysed EITE sectors are estimated to have carried-over around 8% of their total compliance needs for Phase III. Assuming such banking takes place, only the pulp and paper (11%), glass and glass products (18%) and refining (31%) sectors would have to purchase more than 10% of their allowances in Phase III. And in some cases sectors would need to purchase no allowances (e.g. cement, coke oven products, ceramics and bricks).

Figure 11. Direct EU ETS cost estimates after benchmark-based free allocation & banking



Source: Authors, Polish NIM, EUTL.

*Includes electricity auto-generation. **Assumes under-allocation of 21% after accounting for waste-gases.

Figure 11 then shows the revised estimates of the Phase III compliance costs after allowing for the estimated stock of banked allowances being used for compliance in Phase III.

Not surprisingly, factoring in banked allowances significantly reduces the compliance costs in Phase III. This result further reinforces the conclusion that during Phase III of the EU ETS Polish EITE sectors are unlikely to face meaningful risks of carbon leakage as a result of direct compliance costs with the ETS.

3.1.4. Intra-EU Distributional Impact of Benchmarked Free Allocation

The above analysis considers carbon costs from the perspective of carbon leakage. Carbon leakage refers to the shift of economic activity due to different carbon prices between EU and non-EU countries. However, Polish policy-makers are also interested in potential impacts of the EU ETS on the competitiveness of Polish EITEs within the EU.

This raises the question of whether benchmarking results in much higher levels of compensation to EITE installations in the EU15, compared to those in Poland? If this were the case it might be argued that Poland would face a competitiveness disadvantage. This would not result in carbon leakage *per se*. Any shift in production induced thereby would be from less to more carbon efficient installations. Therefore there would be no emissions leakage, indeed emissions would be reduced. Nonetheless, policy-makers are interested in the distributional impacts of benchmarking.

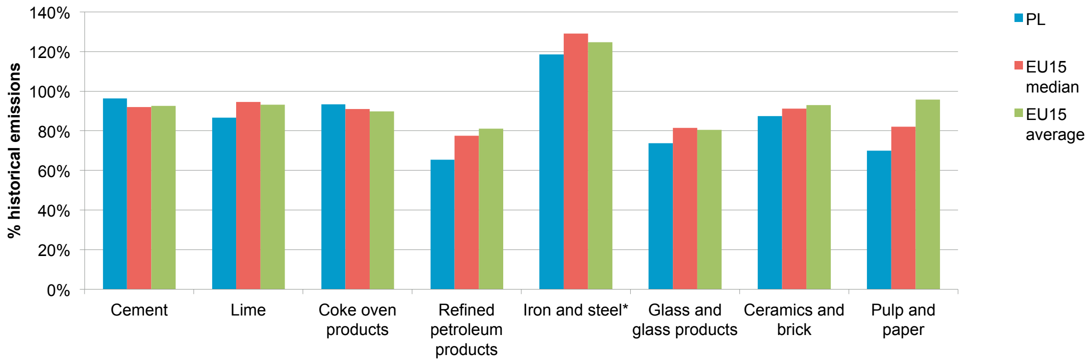
Figure 12 compares the share of historical emissions which will be freely allocated to Poland in ETS Phase III compared to the EU15. Once again, the numbers are calculated using the free allocations data published in the NIMs of each Member State. This figure is then divided by the verified emissions reported in the European Transaction Log (EUTL) in the year representing the "historical activity level" used for determining free allocations under Benchmarking, as above.

The results show that Poland's free allocation levels are broadly similar to the EU15 median and EU15 average. On average Poland is allocated slightly less as a share of its historical emissions than the EU15. However in most cases the difference is around 5 % of historical emissions and in the case of cement and coke it is allocated more than the EU15.

In two cases—refined petroleum products and pulp and paper—the apparent divergence is greater and Poland appears to be allocated more than 10% less of its historical emissions than the EU15 average. However, as noted in section 3.1.2 and figure 9, refined petroleum and pulp and paper are two activities for which the calculation of allocation levels is complicated by the differing extent to which installations auto-produce electricity, the emissions of which then fall within the perimeter of this industrial activity. In Poland, the refinery sector accounts for 29% of total auto-production of electricity compared to 11.7% in the EU15. In the pulp and printing sector it is 20% in Poland vs. 18% in the EU15 (IEA data).

Part of the observed difference in the allocation level to the Polish pulp and paper sector and refinery sector seems likely therefore to be due to the fact that Polish installations in these sectors are more reliant on auto-production of electricity than in the EU15. Their lower allocation level under benchmarking is because they face a shortfall of allowances for this auto-produced electricity. It

Figure 12. Share of historical activity level emissions allocated in Poland versus EU15



Source: Own calculation based on NIM and EUTL.

*Includes allocation for waste gas recycling.

is important to note that installations in the EU15 will purchase electricity for which a carbon price has also been paid. Once this nuance has been taken into account the carbon cost faced by pulp and paper and refinery installations in the EU15 and Poland is likely to be broadly similar.

3.1.5. Summary on Direct Carbon Costs

The evidence presented in the preceding sections suggests that approximately 6-8 key Polish EITE sectors would face significant direct cost increases due to the EU ETS in the absence of free allocation. In several cases these cost increases appear large enough to make these sectors potential candidates for some degree of carbon leakage, depending on the degree of other mitigating circumstances in these product markets. In practice, however, free allocations via the EU ETS's benchmarking mechanism appears to work well in shielding all of these sectors from the lion's share of direct carbon costs. Moreover, in Phase III of the EU ETS, Polish EITE sectors will hold significant stocks of unused freely allocated allowances banked from Phase II. This will allow these sectors to further cover a significant share of their small residual ETS compliance costs.

Consequently, the risks of carbon leakage at carbon prices in the order of 20 to 30€/tCO2 appear negligible for Polish EITEs under the current design of the EU ETS.

3.2. Indirect Carbon Costs

3.2.1. Carbon Price Pass-Through in Electricity Markets

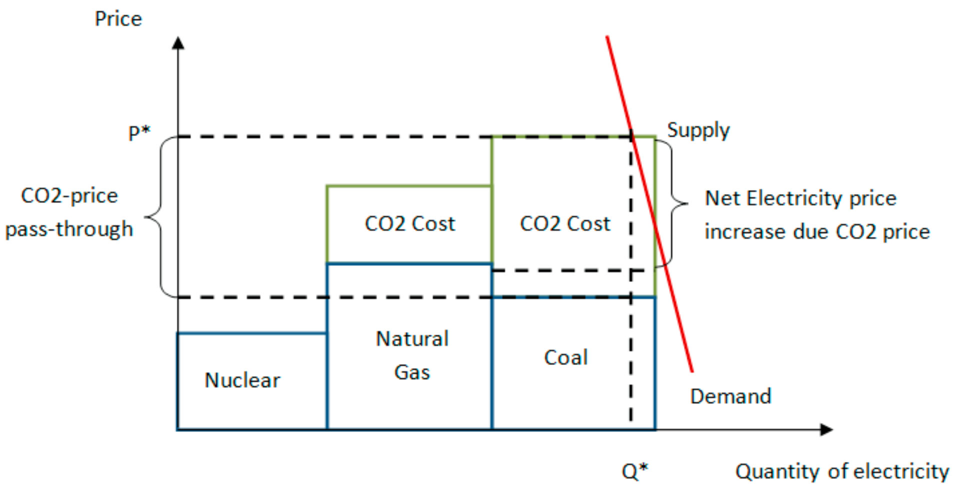
In addition to direct compliance costs for CO2 emitted from an installation, EITE companies may also face increased costs because of the higher price of electricity that is created by the EU ETS. This can occur because marginal fossil-fuel powered generators in the electricity market will tend to include the (opportunity) cost of their own emissions allowances into the prices they charge to electricity consumers (Sijm et al, 2006).

Figure 13 offers a stylised example of the way the CO2 price faced by electricity generators can be passed through to consumers in electricity prices. In liberalised markets it is the marginal generation technology—in this case coal-fired generation—which sets the market price for electricity (P*). In the presence of CO2 costs each technology in the supply curve or "merit order" will face different CO2 costs as a function of the carbon intensity of its input fuel. Thus, where coal is the marginal generator, the market electricity unit price will include the CO2 costs related to producing that unit from coal fired generation.

Therefore, the CO2-intensity of the *marginal* generation technologies and the prevailing CO2 price determine the pass-through rate in a given electricity market. Conversely, the *average* CO2-intensity of the entire supply curve does not necessarily matter for the pass-through rate. It follows that Poland's much greater share of coal-fired generation than other EU countries does not necessarily mean that Poland faces much greater CO2 cost pass-through rates. Other countries can still have similar amounts of *marginal* generation from coal-fired power plants, despite very different *average* CO2-intensities in their electricity mixes.

This explains why the CO2-cost pass-through rates for Poland, as estimated by the European Commission's DG Competition, are only moderately larger than other Western European countries despite it much greater average reliance on coal and lignite in its generation mix. For example, Polish electricity market's pass-through rate is estimated to be 0.88 tCO2/MWh while Central and Western Europe's pass-through rate is 0.76 tCO2/

Figure 13. Stylized example of CO_2 cost pass-through in an electricity market



Source: Authors' own representation.

MWh and the EU15 average is 0.69 tCO2/MWh (EC, 2012).

In Phase III of the EU ETS, Poland will be eligible for transitional free-allocation to electricity generation. However, it should be noted that free allocation does not necessarily prevent electricity generators from passing through the opportunity cost of free allowances into the electricity price, as Sijm et al (2006) have shown empirically. However, the Polish electricity market is also still partially regulated, which may reduce the extent of pass-through of the value of freely allocated permits into electricity prices.

These considerations mean that Poland's industry is unlikely to face dramatically different indirect carbon costs compared to the EU15, despite the much higher *average* CO_2 intensity of Poland's electricity production.

3.2.2. Hypothetical Case of Indirect Carbon Costs in Polish Industry without Mitigating Measures

Only a small handful of industrial sectors are electro-intensive in Poland. Figure 14 shows estimates of the share of GVA at stake for NACE 2-digit sectors[8] due to indirect carbon costs in Poland. It is assumed that carbon prices are 20 and 30 €/tCO2 and the average pass-through rate is 0.88 tCO2/MWh. These results *exclude the impact of state-aid compensation*. Only 3 broad sectors—non-ferrous metals, iron and steel, and chemicals, petrochemicals and refined petroleum products—stand out as having over 5% of GVA at stake at carbon prices of 30€/tCO2 and thus as having a potentially significant cost burden as a result of the EU ETS in the absence of compensation.

Meanwhile, five other sectors are found to have around 2 to 3% of GVA at stake—pulp, paper and print, mining, non-metallic minerals, wood products, and non-specified manufacturing. In practice, the results for these five sectors (as well as the other sectors) are likely to reflect aggregation affects to varying degrees, since more electricity-intensive sub-sectors exist within the NACE 2-digit aggregates. Unfortunately, electricity consumption data by subsector are not publically available. Therefore, we focus only on the top four sectors for the purposes of this analysis. Thus, it needs to be kept in mind that individual subsectors' results may differ from the broader sectoral aggregates presented in this section.

3.2.3. Best Estimate Case of Indirect Carbon Costs with Compensation

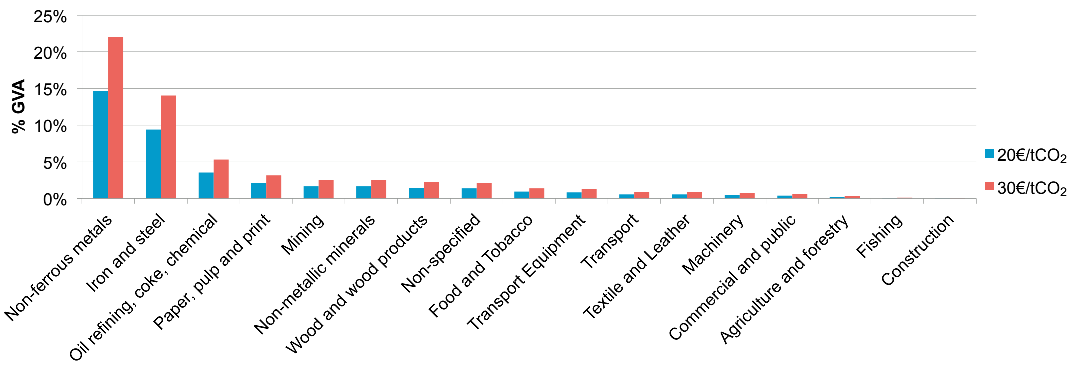
In Phase III of the EU ETS Member States may provide monetary compensation to electro-intensive activities. These are defined as industries whose indirect CO2 costs represent 5% or more of GVA and whose trade-intensity with third countries is 10% or more of the relevant market. The maximum amount of aid that may be provided in year t ($Amax_t$) per installation is determined by the formula:

$$Amax_t = A_{it} \times C_t \times P_{t-1} \times E \times BO \quad (1)$$

Where A_{it} is the maximum allowable aid intensity at year t, expressed as a fraction (e.g. 0.8); Ct

8. Due to data limitations, refined petroleum products, chemicals and petrochemical sectors are aggregated together.

Figure 14. Indirect carbon costs as a share of sectoral GVA (NACE 2- and 3-digit level)



Source: Own calculation, IEA Online Energy Statistics, Eurostat, EC (2012).

is the applicable CO2 emission factor (tCO2/MWh) (at year t); Pt-1 is the EUA forward price at year t-1 (EUR/tCO2); E is the applicable product-specific electricity consumption efficiency benchmark defined in Annex III of the State aid guidelines; and BO is the baseline output (EC, 2012).

The maximum aid intensity used in this formula, A_{it}, declines gradually over the course of Phase III, from 0.85 during 2013-2015 to 0.8 during 2016-2018 to 0.75 during 2019-2020. It is therefore important to examine the impact which this compensation would have on the indirect costs faced by Polish electro-intensive sectors if applied in Poland.

Figure 15 shows this calculation for Poland assuming carbon prices of 20 or 30 €/tCO2, pass-through rates of 0.88 tCO2/MWh and aid intensity of 0.75. These are quite stringent assumptions: i.e. a high carbon price, and the lowest aid intensity applicable in Phase III.

After this state aid is taken into account, the indirect cost estimates fall to relatively low levels. Only non-ferrous metals and iron and steel are found to still have non-negligible costs as a share of GVA at 3.5 to 5.5% and 2 to 3.5% respectively. These figures are also likely to overstate the cost to the iron and steel sector since for this sector a significant share[9] of electricity consumption produced from recovered waste gases is also compensated via direct free allocation of allowances (see notes to Figure 8). These results would suggest that the impact of indirect costs is relatively small for these 2-digit sectors if Poland were to allocate state aid at the 75% aid intensity.

However, there are two caveats to this conclusion. Firstly, the results presented in Figure 15 are based on 2-digit and 3-digit sectoral aggregates (and in the case of chemicals and petro-chemicals and refining a sum of two 2-digit sectoral aggregates). More electricity- intensive sub-sectors could have slightly higher cost intensities after state aid. For example, the aluminium sector, although very small in Poland, will have a higher electricity intensity and hence higher indirect carbon costs than copper and other non-ferrous metals included in the non-ferrous metals aggregate.

Secondly, the estimates presented in Figure 15 assume that Poland has the budgetary capacity to allocate the maximum allowable state aid to its electro-intensive industries. This may not always be a realistic assumption. In a situation of competition for scarce budgetary resources, Poland may decide not to allocate the maximum state aid. This could expose these sectors to competitiveness distortions with producers in other countries, either participating in the EU ETS or outside of it. Figure 16 tests the potential implications of one such scenario. In compares the impacts of a 50% state aid intensity to a state aid intensity of 75%, as in figure 15. The results in figure 16 suggest that certain sectors, with a higher ratio of costs to GVA to begin with, such as non-ferrous metals, may indeed face significant cost burdens if the full state aid amount is not allocated.

It needs to be stressed that the scenario outlined in Figure 16 is at this stage purely hypothetical. In practice it could be argued that the current design of the EU ETS does provide a significant new means of financing these state aid payments in the form of revenues from auctioning emissions allowances to the electricity sector. Poland is actually a net beneficiary of the intra-EU transfers of auctioning revenues, which are one of the key mechanisms in

9. According to the European Commission's Benchmarking Regulation (EC, 2011a), approximately 85% of the waste gases benchmark which are used to auto-produce electricity are compensated by free allocation in the setting of the iron and steel benchmarks.

Figure 15. Indirect CO_2 cost estimates assuming 75% aid intensity

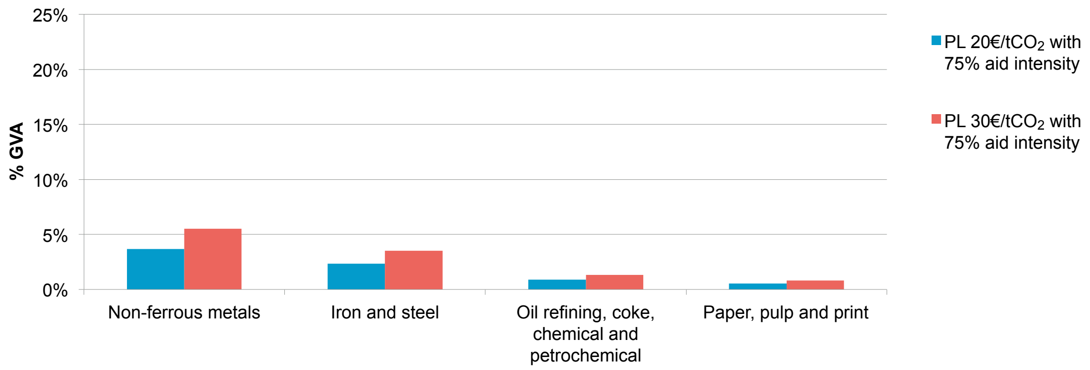
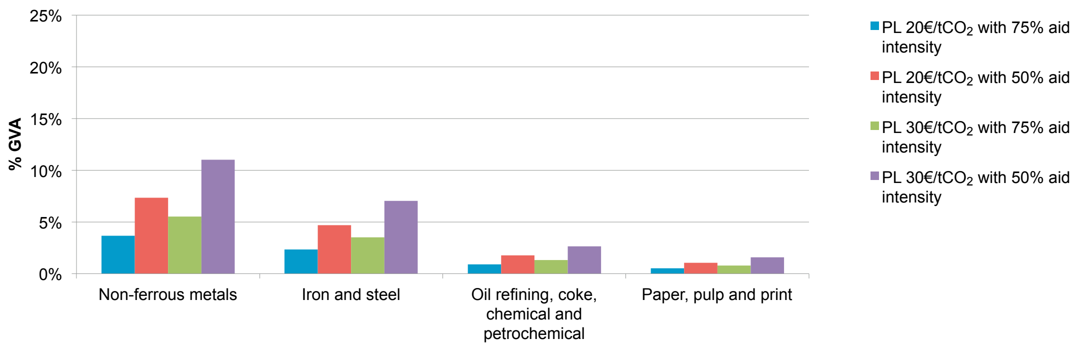


Figure 16. Indirect CO_2 costs after state aid compensation (comparison of 50% vs. 75% aid intensities)



the 2008 Climate and Energy Package to mitigate the implementation costs for less wealthy Member States. Furthermore, Poland's electricity sector will receive a transitional free allocation in Phase III, which is intended to mitigate some indirect carbon costs for Polish electricity consumers

3.2.4. Summary of Indirect Carbon Costs

In summary: a small number of Polish EITE sectors would be particularly exposed to indirect carbon costs via increased prices of electricity, to the extent that such a price increase were to arise despite transitional free allocation to the Polish electricity sector in Phase III.

In practice, the compensation mechanism provided for under EU state aid guidelines allow for all but a relatively small residual share of these costs to be mitigated in the four sectors examined here. However, these compensation measures are optional and rely on a decentralized mechanism of direct budgetary compensation. Despite the generation of significant revenues from auctioning in the EU ETS in Phase III, some governments may be unwilling or unable to directly compensate electro-intensive industries. This could create risks of distortions to the internal market and potentially carbon leakage to non-ETS countries.

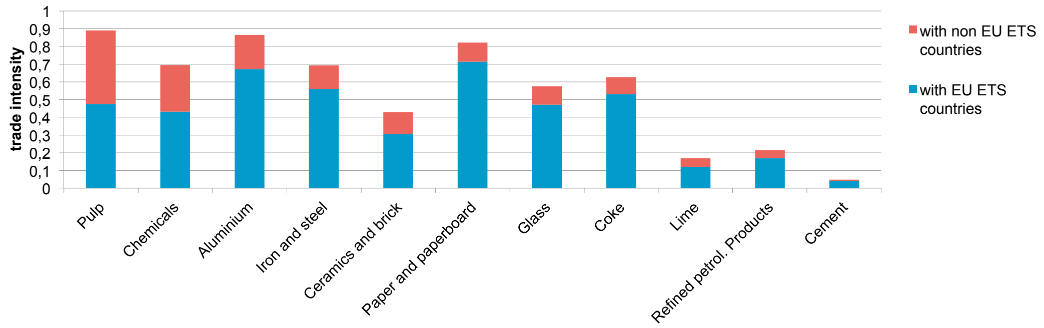
Particularly in the present context of intensive fiscal consolidation in the EU, this appears to be a conceivable possibility for some Member States. The current decentralised approach to compensating EITE sectors for indirect carbon costs may therefore be a subject meriting further review in the development of the EU's post-2020 Climate and Energy Package. This subject may be of particular concern to Poland given its propensity for somewhat higher average carbon cost pass-through rates in its electricity sector.

3.3. Poland's Trade Relationships in Energy Intensive Industrial Sectors

3.3.1. The Trade Intensity of Poland's Industrial Sectors

We showed above that for some sectors, in a scenario without free allocation, carbon costs may be a significant share of overall production costs. In highly traded, intensely competitive sectors, small differences in production costs may impact on comparative advantage. Therefore, if carbon costs are significant relative to overall production costs, differences in carbon pricing may lead to carbon leakage. It is therefore

Figure 17. EU ETS and non-EU ETS trade intensity of Polish industrial sectors



Source: Own calculation, based on Eurostat's Structural Business Statistics and International Trade Data.

important to also assess the trade intensity of industrial sectors when considering their risk of carbon leakage.

The Commission has done so at a European level in establishing the list of sectors exposed to carbon leakage and hence eligible for benchmarked free allocation (EC, 2010a). Under the Commission's assessment, a sector is considered at risk of carbon leakage if:

- Its direct and indirect carbon cost exposure is above 5% of GVA, *and* its non-EU trade intensity is above 10%; *or*
- Its non-EU trade intensity is above 30%.

The Commission used the following equation to assess a sector's trade intensity:

$$\textit{Sectoral trade intensity} = \frac{X + M}{M + Y}$$

Where: X = total value of non-EU exports; M = total value of non-EU imports; Y = total turnover of EU production

In other words, for each sector the equation represents total trade with non-EU countries relative to the size of the EU market (imports plus domestic turnover). The Commission used the PRODCOM database for both data on exports, imports and turnover. The data used, with a few exceptions, at the four digit level of disaggregation, using the NACE Rev. 1 statistical classification of economic activities. The calculation therefore gives the trade intensity of industrial sectors at the level of the EU.

We broaden this analysis to assess the trade intensity of Poland's industrial sectors. In doing so we assess both EU and non EU trade intensity. This allows us to show how much of Poland's trade is currently within the EU, i.e. with countries covered by the ETS. However, this analysis encountered data issues: for confidentiality reasons, *national-level* trade data is often incomplete in the PRODCOM database. We were therefore unable to repeat the Commission's methodology based on the PRODCOM data.

Instead we used the International Trade Data of Eurostat, using the Standard International Trade Classification (SITC). This gave us export and import data at four digit level. However, national level production data is not available using the SITC classification of economic sectors. Instead we used the Structural Business Statistics of Eurostat, which uses the NACE Rev 1. This therefore necessitated the matching of two different sectoral classification systems, in order to ensure that import and export data for one sector corresponds to production data for the same sector.

This matching process will inevitably lead to some errors, as the overlap of the sectoral definitions will not be completely the same. However, in the absence of other data, this was the only possible way to estimate the trade intensity of Polish industrial sectors. **Overall the data given below can be taken as a reasonable estimation of trade intensity of Polish industrial sectors, given the data deficiencies that exist.**

Figure 17 gives the estimated trade intensity of Polish industrial sectors. The blue represents Poland's trade intensity with all countries covered by the EU ETS. The red bar represents Poland's trade intensity with non-ETS countries, i.e. the rest of the world. The sum of both bars represents the total trade intensity for the sector.

It can be seen that apart from two sectors, pulp and chemicals, trade with EU ETS countries dominates. Secondly, the sectors have a reasonably high trade intensity, except lime, cement and refined petroleum products. Below we discuss some of the factors that may explain this high trade intensity with other EU ETS countries, and what its implications could be for carbon leakage.

3.3.2. Poland's Key Trading Partners in EITE Sectors

It is also useful to look at who Poland is trading with. It is sometimes heard that Poland, as a country on the European periphery, is more exposed to trade with non-EU European countries, such as Russia, Turkey or Ukraine. Figure 18 shows Poland's main trading partners by industrial sector. This simply represents per sector the sum of Poland's imports and exports with the given country, divided by Poland's total imports and exports in the sector, i.e.:

$$\text{Sectoral trade share} = \frac{Ij + Ej}{It + Et}$$

Where Ij = Poland's imports from country j; Ej = Poland's exports to country j; It= Poland's total imports; Et = Poland's total exports.

This was calculated only using the *Eurostat International Trade Data*, so none of the caveats regarding data matching for the above calculation in figure 17 apply.

It can be seen that the majority of Poland's trade exchanges take place within the EU. The non-weighted average share of the EU within Poland's total trade exchanges in these industrial sectors is 79%; within this, the non-weighted average for Germany is 27%. Russia, Ukraine and Turkey have a non-weighted average share in total Polish trade of 8%. This is significantly influenced by high share of Russia in Polish trade in the pulp and waste paper board sector (12%), and the rubber sector (16%). Pulp production is an energy intensive process; waste paper and rubber are not. The aggregation of the data means that it is not possible to assess what share of trade exchanges in the pulp and waste paper sector is composed of pulp, which is likely to have a lower trade intensity than the sector as a whole.

3.3.3. Carbon Cost Differences, Barriers to Trade and "Border Effects"

This section showed that energy intensive sectors in Poland (and the EU) generally have quite high trade intensities, but that these trade intensities were markedly lower for Polish trade with non-EU ETS countries. This result strongly suggests that there are higher barriers to trade between Poland and non-EU/EEA countries than between Poland and EU countries. This raises two questions: a) what are these barriers? b) to what extent could these trade barriers mitigate carbon leakage even in the event of carbon cost differences between Poland and non-EU competitors.

In general, there are numerous barriers to trade and thus to the penetration of domestic markets by imports. The most obvious are the cost of transporting goods between countries and border tariffs or quotas. For example, Grossman (2008) reports that the average free on-board transport costs of exports is approximately 5% of value added and the EU currently applies duties in the range of 0-6% of Value added to imports of energy-intensive materials into the EU single market (WTO, 2013), (although average applied rates have fallen in the past for some of these and may fall further under future trade agreements). Although these costs are now quite low by historical standards, they are still likely to contribute to the higher intensity of domestic and intra-EU commerce than with non-EU countries.

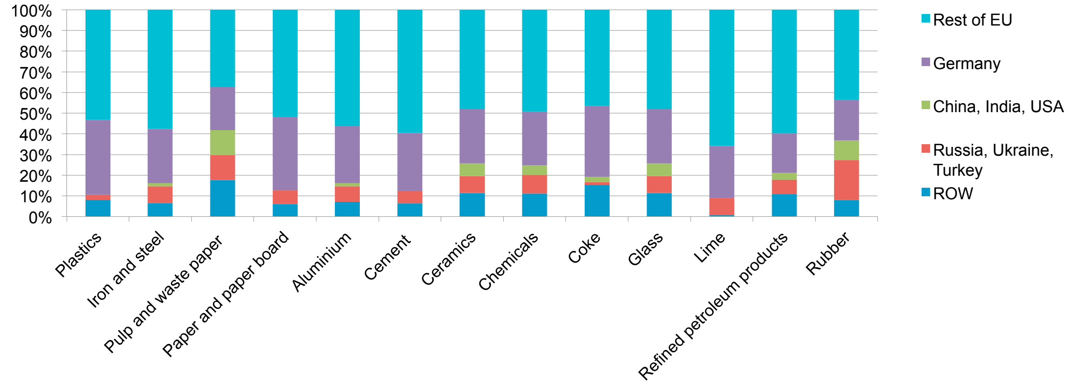
In addition, the recent trade literature has identified very strong effects of national borders in limiting import penetration into domestic markets which cannot be accounted for by traditional measures of trade barriers such as transport distance or formal trade barriers. These "border effects" are used to account for the observed strong "home bias" of commerce across most industries. This idea was first introduced by McCallum (1995), who found that Canadian provinces tended to trade with each other 22 times more than with neighbouring states of the U.S. even after controlling for the effects of distance and despite low formal trade barriers. This result has since been confirmed by Helliwell (1997, 1998, 2001) and Wolf (1997) and shown to exist for the OECD as a whole by Wei (1996). Head and Mayer (2000, 2001, 2004), Chen (2004) and Nitsch (2000) have shown that this result describes trade flows for EU countries as well and Head and Mayer (2001) have shown that the EU single market has led to a reduction of border effects within the EU and a simultaneous strengthening of the border effect of EU countries with respect to non-EU countries[10].

Border effects therefore offer an explanation for the much lower import penetration of Polish and EU markets by foreign competitors.

Estimates of the size of border effects for EU countries vary somewhat between studies and depend a lot on the way it is measured. Head and Mayer (2004) and Chen (2004) also find that the home bias varies across sectors. With respect to energy-intensive manufacturing, Head and Mayer (2004) find that border effects raised the volume of intra-country trade by a factor of 2.2 for basic metal products, 8 for non-metallic minerals, 5 for chemicals and fibers, 12.5 for pulp paper and printing, and 13 for rubber and plastics. These estimates refer to the average border effects of these industries in Italy, UK, Germany, and France between 1988 and 1995. Similar magnitudes are also found by Chen (2001).

10. The exact causes of the home bias effect are still not that well understood in the trade literature. Prominent explanations refer to structural, competition and informational factors (e.g. Nitsch, 2000).

Figure 18. Country trade shares in Poland's total trade exchanges by industrial sector



Source: Own calculation based on Eurostat's International Trade Data

Since the precise causes of border effects are not well understood, it is difficult to make solid predictions about the extent to which they might protect from carbon leakage. However, it is clear from the data presented above that barriers exist to entry into Polish and EU markets for products coming from third countries. It is reasonable to conclude that the existence of both formal as well as these informal trade barriers such as home bias is likely to limit, although not necessary remove, the potential for carbon leakage to a certain extent.

4. CONCLUSIONS

Overall, the results suggest that there is a negligible risk of carbon leakage in Poland under current policy settings. The mitigating measures provided for in the EU Directive are effective at removing the vast majority of direct and indirect carbon costs for Polish industry, even with carbon prices of up to €30/ton, well in excess of current prices.

Looking forward, the results suggest that, firstly, EU climate policy can be made more stringent without inducing risks of significant carbon leakage. The current benchmarking system appears to be reasonably effective at providing a level playing field while not structurally disadvantaging less carbon efficient Member States like Poland. Secondly, it seems vital to maintain a harmonized climate policy for the industrial and electricity sector. Without this, the internal market would be exposed to unacceptable risks of distortion. Finding a harmonized mechanism to deal with indirect carbon costs may be a key to unlocking Polish support to future policy developments.

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ANNEX

Costs and Other Sources of Comparative Advantage

A significant carbon cost difference between EU ETS and foreign non-EU ETS producers will not necessary equate to carbon leakage. A range of other factors could still mitigate leakage despite carbon cost differences between countries.

Firms competing in imperfectly competitive markets may have some ability to pass-through increased costs to customers in their sale prices; firms may have some ability to reduce their emissions-intensity of production via abatement options that are cheaper than the carbon price; foreign rivals may face prohibitive transport, tariff, exchange rate or other cost differences; competition in sectors with non-homogeneous products may be based more on differences in product quality rather than costs. In addition, domestic purchasers may place a premium on producer proximity (for example to avoid risks of supply chain disruptions, to avoid exchange-rate risk, to facilitate communication on product design specifications, timing of delivery, access to credit, etc). In the short and medium term, shortages of available export capacity in foreign countries, or sunk costs in plant and equipment domestically, can prevent foreign import penetration into domestic markets.

Finally, energy-intensive producers in foreign countries may have implicit rather than explicit carbon costs to contend with. For example, China has begun placing sometimes significant export taxes on energy-intensive products which, in part, reflect climate policy goals. Wang et al (2010) have shown that the implicit (shadow) carbon price of China's export taxes on energy intensive manufacturing products is of a comparable order of magnitude as the explicit carbon price of the EU ETS. Similarly, renewable energy promotion policies, such as renewable obligation certificate schemes which currently operate in numerous countries, can add implicit carbon costs into the price of electricity for electro-intensive industries (Berghmans, 2012). Research by the Australian Productivity Commission has shown that implicit carbon prices arising from such policies can be comparable to and often indeed much higher than the explicit carbon price operating in the EU ETS (Australian Government, 2011).

A number of factors can thus mitigate against carbon leakage risks even despite differences in explicit carbon costs between countries.

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