

The European Chlor-Alkali industry: an electricity intensive sector exposed to carbon leakage

The revised EU ETS (Emission Trading Scheme) Directive 2009/29/EC will have financial consequences for all energy-intensive industries. The chlor-alkali industry is in particular exposed to a significant risk of carbon leakage due to CO₂ costs passed through in the electricity prices. The Directive recognises the need to avoid carbon leakage whilst at the same time fulfilling the climate change objective of reducing CO₂ emissions and, consequently, it allows Member States to adopt financial measures to compensate energy-intensive sectors for the additional costs of carbon passed through in electricity prices.

This document aims at explaining why and how the chlor-alkali industry is highly impacted by the EU Emission Trading Scheme.

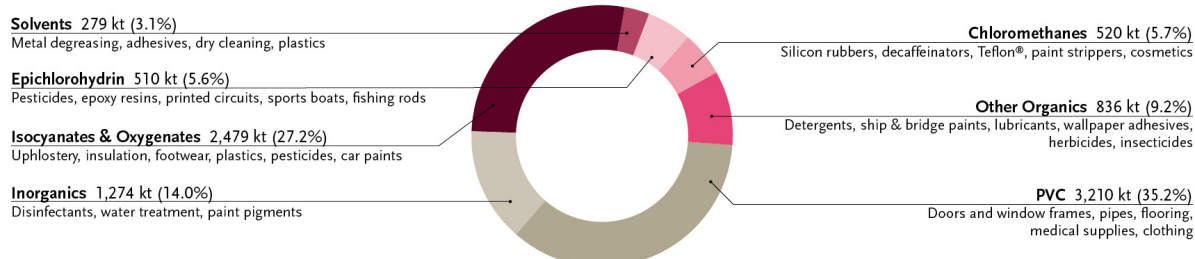
1. The chlor-alkali industry

1.1. The importance of the European chlor-alkali industry

Chlorine and caustic soda are basic building blocks for thousands of useful substances and products. The chlor-alkali industry underpins about 55% of the European chemicals and pharmaceuticals industry which realised in 2009 a turnover of almost 660 billion euro. About 20 million tonnes of chlorine, caustic soda and hydrogen are produced each year at 76 manufacturing sites in 22 European countries. The chlor-alkali sector employs about 39,000 people.

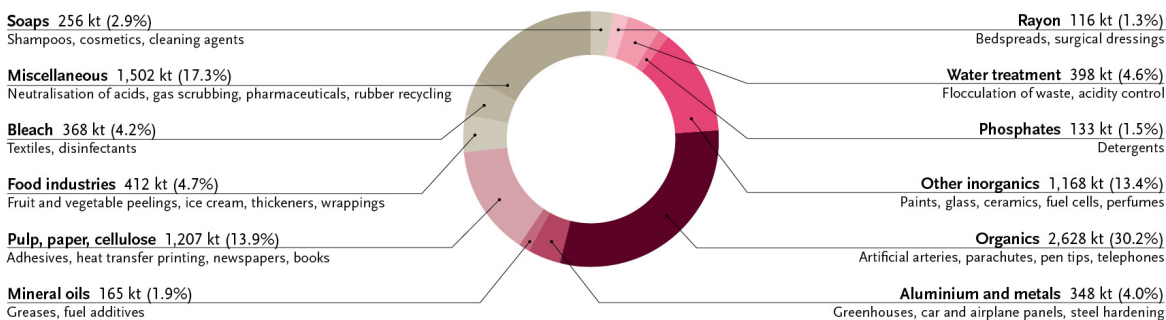
About two thirds of European chlorine production is used in engineering materials – polymers, resins and elastomers. The largest single end use (35%) is PVC plastic for primarily the construction, automotive, electronic and electrical industries. The manufacturing processes of many chemicals, plastics and medicines use chlorine, although the end product is chlorine-free, such as the plastics polyurethane and polycarbonate which have increasing numbers of applications.

European chlorine applications in 2009
9,108 kilotonnes



The co-product caustic soda is used in various industries (e.g. metallurgy, aluminium, glass, soap, detergents and textiles).

European caustic soda applications in 2009 8,701 kilotonnes



Hydrogen is mostly recycled as a chemical raw material or is used as fuel to produce steam. Technologies are today in industrial development to allow for local electricity recovery via fuel cells.

1.2. Energy use in the chlor-alkali industry

Electricity

Basically, producing chlorine and caustic soda comes down to passing an electric current through brine (a solution of salt – sodium chloride – in water). The brine dissociates and recombines through exchange of electrons (delivered by the current) into gaseous chlorine, dissolved caustic soda¹ and hydrogen. By the nature of the chemical reaction, chlorine, caustic soda and hydrogen are always manufactured in a fixed ratio: 1.1 tonne of caustic and 0.03 tonne of hydrogen per tonne of chlorine. This product combination is called an Electrochemical Unit or ECU.

The average electricity consumption of a chlorine electrolysis plant is about 3.3 MWh per ECU. About 90% of the electric current is used as raw material which cannot be substituted. The reduction potential of the consumption is therefore limited and is mainly due to technology shift from mercury cell to membrane technology together with smaller efficiency measures in the production units (see hereafter).

About 10% of the electricity is used for lighting and operating pumps, compressors and other necessary equipment.

Steam

Also steam is needed in the chlor-alkali production e.g. for salt preparation and concentration of the caustic soda. How much steam is necessary depends on the production process used in the plant (see hereafter).

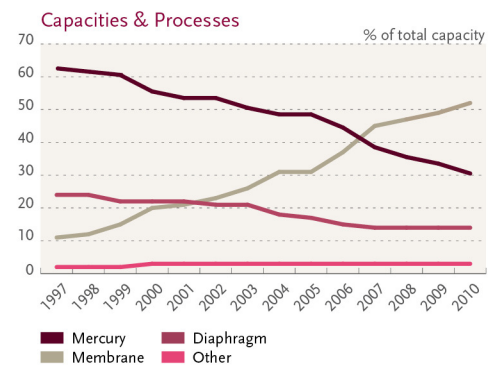
1.3. Three different production technologies

There are three main production technologies to produce chlorine:

- **membrane** technology represents almost half (52%) of the installed production capacity in Europe.
- **mercury** process accounts for 31%
- **diaphragm** process for about 14%.

¹ In some processes, potash (KOH) is produced instead of caustic soda (NaOH). These companies are also considered part of the chlor-alkali sector.

The membrane technology and non-asbestos diaphragm technology are considered best available technologies (BAT) under the IPPC (Integrated Pollution Prevention and Control) Directive. The industry has a voluntary agreement in place, which has been officially recognised by the European Commission, to phase out the mercury cell technology by year 2020². The gradual change of technologies is shown in the graph.



The technology shift from mercury cells to membrane will lead to a lower electricity consumption in the sector. A membrane plant uses less electricity than a mercury plant, but requires more steam in order to obtain the standard commercial concentration of caustic soda. The differences in energy consumption between the three processes are listed below:

kWh / tonne ECU	Mercury process	Diaphragm process (asbestos)	Membrane process
Electrolysis cells	3360	2720	2650
Power and light	200	250	140
Total electricity	3560	2970	2790
Steam consumption ³	0	610	180
Total	3560	3580	2970

(Source: EU chlor-alkali BREF 2001)

The average electricity consumption per tonne of chlorine produced equals a CO₂ emission of about 2.1 tonnes. However, the chlor-alkali industry does not emit CO₂, instead the emissions occur during the production of the electricity that the sector uses i.e. the chlor-alkali industry is an indirect emitter of CO₂.

1.4. Production costs differences determine global competitiveness

Because electricity is a raw material for chlor-alkali production its price has a substantial impact on the production cost. Electricity accounts for about 50% of the total cash production cost (that is the sum of the cost of raw materials, labour cost, maintenance costs, overhead costs and taxes). Thus, it is a critical factor in the global competitiveness of European producers and the sector is very sensitive to regional differences in energy prices.

The cost of chlor-alkali production in Europe is relatively comparable with the United States but already quite higher than the production cost in Russia and much higher than in Saudi-Arabia and China. This is due to the fact that energy cost in these regions is only a fraction of the energy cost in Europe. One reason is that the EU is the only region/country in the world that has a legally binding emission trading system in place.

² For the production of chlorine, alkali hydroxides and hydrogen.

³ Based on the production of 250 kWh electricity for 1 tonne of steam.

2. EU Emission Trading Scheme (ETS) impact on the European chlor-alkali industry

2.1. The EU Emission Trading Scheme

The EU Emission Trading Scheme is a cap and trade system of greenhouse gas emission allowance within the Community. The first trading period ran from 2005-2007, the second one from 2008-2012. The ETS Directive was revised in 2009 in view of the third trading period which will start in 2013. The great majority of allowances have been allocated free of charge to installations in the first and second trading periods, auctioning of allowances should become the basic principle of the third period.

From 2013 onwards electricity generators has to buy their emission allowances as they are considered being able to pass on this cost to their customers. In other sectors, free allowances will be progressively phased out, starting at 20% auctioning in 2013, increasing to 70% in 2020 with a view to reaching 100% in 2027. An exception will be made for installations in sectors that are exposed to a significant risk of “carbon leakage”. This means that there is a risk that companies relocate the production to areas outside the EU that are not subject to comparable emission constraints. Installations in exposed sectors will receive 100% free allowances.

CO₂ costs passed on in electricity prices could also expose installations to the risk of carbon leakage. In order to avoid such risk, Member States may grant financial measures to compensate for such costs.

2.2. How does this affect the chlor-alkali industry?

The ETS directive leads to a competitive disadvantage of the European manufacturers' vis-à-vis its competitors. For electro-intensive industries, such as the chlor-alkali industry, that uses electricity as a raw material and that competes on the global market, the possibilities to pass on the CO₂ costs are very limited.

The import and export of chlorine is limited (due to the hazardous properties of the chemical), the markets of the downstream products e.g. Ethylene Dichloride (EDC) and Poly Vinyl Chloride (PVC) are global and highly competitive. Reduced profitability of producing in Europe will stimulate investments in other regions, e.g. China, and to use these sites as a basis for export to Europe. Over time investment in the European chlor-alkali industry will cease in favour of other parts of the world leading to “carbon leakage”.

Considering that chlorine is one of the most widely used chemicals, present as feedstock or as an intermediate in a large number of chemical processes, the impact will go beyond the chlor-alkali industry and will also affect operations and employment in the European chemical industry at large.

2.3. The chlor-alkali industry - an exposed sector

The European Commission published in December 2009 the list of sectors and subsectors exposed to a significant risk of carbon leakage according to the criteria set in the revised ETS Directive. The assessment has been made at sectoral level and the chlor-alkali industry is included in the sector basic inorganic chemicals which qualify as an exposed sector.

In addition, the chlor-alkali industry has commissioned an independent consultant to prepare a qualitative assessment of the two criteria (cost of CO₂ as a % of GVA (Gross Value Added) and extra-EU trade impact) specifically for the chlor-alkali industry. The assessment shows conclusively that the chlor-alkali industry on its own meets the exposure criteria set up by the Commission.

2.4. Compensation for indirect CO₂ costs

For electro-intensive industries such as the chlor-alkali industry, significant costs occur due to the cost of carbon being passed through in electricity prices. The revised ETS Directive does not foresee granting free allowances for such sectors. Instead the risk of carbon leakage has been addressed in Article 10a 6, which gives the Member States possibilities to provide financial compensation in the form of state aid.

The directive states that the financial compensation to be based on ex-ante benchmarks calculated for a given sector or sub-sector as the product of the electricity consumption per unit of production corresponding to the most efficient available technologies and of the CO₂ emissions of the relevant European electricity production mix. The proposed compensation scheme will be published by the Commission in the near future.

The European chlor-alkali industry has expressed its willingness to contribute to the further development by the European Commission of the State Aid Guidelines. ■