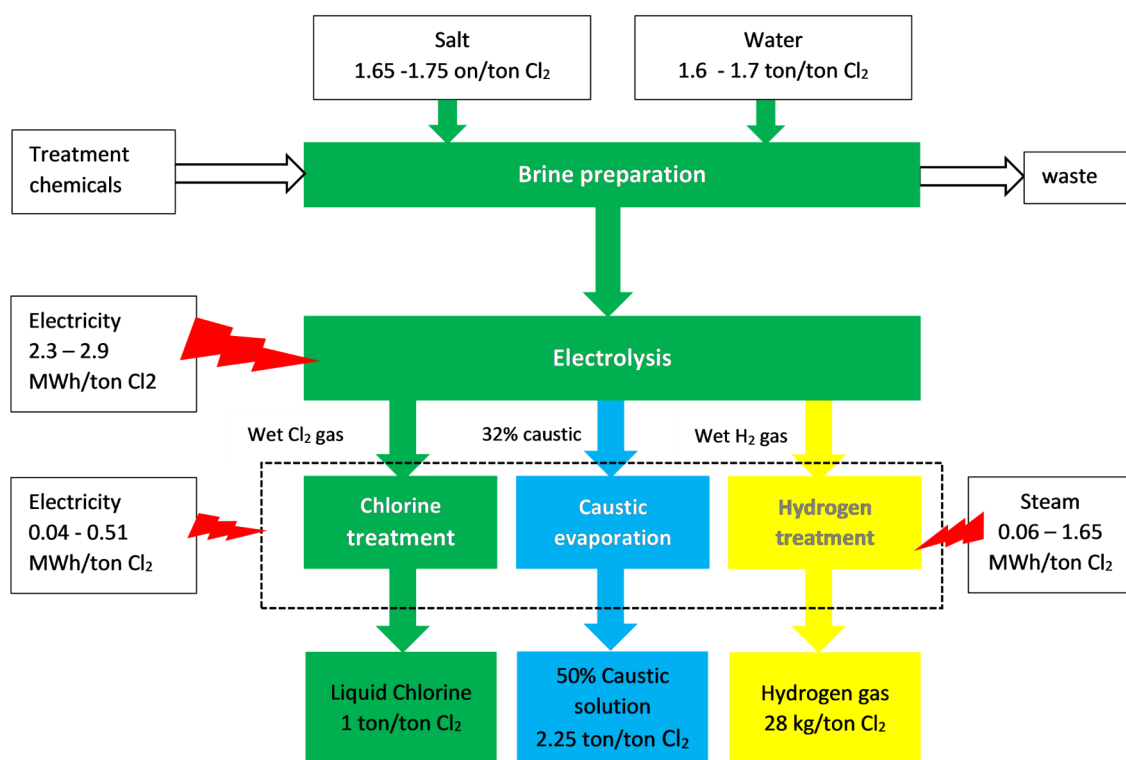


# Electrolysis and production costs

As explained in our information sheet on its thermodynamics (Information Sheet 11), the production of chlorine, caustic soda (KOH or NaOH) and hydrogen by the European chlor-alkali industry requires salt, water and a large amount of energy under the form of electricity and steam.

A schematic overview of the membrane production process (one of the main technologies to produce chlor-alkali), including the main material streams, is presented below. The membrane process is of particular interest because around 86% of chlorine produced in Europe comes from this technology (2023 figures). The electricity consumption is based on the Euro Chlor sustainability data collection and the other consumption figures result from

the BREF chlor-alkali and the 2022 Euro Chlor Eco-profile report. The costs are extracted from a comprehensive study contracted to an external consultant. Based on the amount of chlor-alkali produced and the current prices for electricity, steam and the required raw materials, it is possible to calculate the production costs of chlorine, caustic and hydrogen.



Overview of the chlor-alkali production process and the main material flows.

(brine = high concentration solution of salt in water)



Component	Use per ton neCl <sub>2</sub>	Unit cost	Cost range per tonne Cl <sub>2</sub>	% of total costs
Electricity - electrolysis unit	2.27 - 2.94 MWh	€140 - 162	€318 - 476	67 - 77
- rest of plant	0.04 - 0.52 MWh	€140 - 162	€6 - 84	1 - 12
Salt	1.65 - 1.75 tonne	€40 - 70	€66 - 123	16 - 17
Steam, water, treatment chemicals		€22 - 23	€22 - 23	3 - 5
<b>Total</b>			<b>€412 - 706</b>	

*Table 1: Overview of the variable costs in the membrane process. Unit cost is the cost of each MWh/tonne or m<sup>3</sup> of each key component*

The cost of salt depends on its type (quality) and source (brine/evaporated salt, rock salt/sea salt) and the distance it has to be transported. The purity of the salt, typically varying between 95% and 99.9%, also influences the amount of other treatment chemicals needed to achieve the required brine quality level. Whilst lower purity salt may be cheaper, it will require more treatment chemicals.

The relative costs of electricity, salt, water, treatment chemicals and steam prices per unit are taken from our latest competitiveness study. Despite the large variations in variable costs Table 1 may display, it can be concluded that the electricity costs dominate the overall picture.

Finally, there are additional manufacturing (“fixed”) costs to be taken into account. These cover manpower, maintenance, overheads, insurance and tax. The previously mentioned study estimates these fixed costs at being between €147 and €183 per ton Cl<sub>2</sub>.

Overall, the cost range, per ton Cl<sub>2</sub>, varies between €559 and €889 with the associated electricity costs ranging between €324 and €560.

#### Conclusion:

The cost of electricity accounts for 58-62% of the total production cost.

The cost of electricity accounts for 68-89% of the variable cost.

Much more about chlor-alkali at [www.eurochlor.org](http://www.eurochlor.org) and our industry at [www.chlorineindustryreview.com](http://www.chlorineindustryreview.com).

