# PROJECT PROGRESS

## Chemicals and Fertilizers

### Chemical sector

Looking towards 2050, the European chemical industry has the potential to be the building block to the transition to carbon neutrality as an innovative industry. In this direction the new chemicals and materials must be safe and at the same time sustainable. Based on this, the EU has a comprehensive framework comprising approximately 40 legislative instruments. The industry consists of 30,000 companies, 95% of which are small and medium-size enterprises, directly employing approximately 1.2 million people and 3.6 million indirectly. EU turnover was €565 billion, where Germany and France are the two largest chemicals producers in Europe, followed by Italy and the Netherlands.
Currently, Europe is the 2nd biggest chemical producer accounting for 16.9% with decreasing trends, due to the increased competition from other regions, by comparably high energy prices, lagging innovation, currency appreciation, high labour costs, and regulatory and tax burdens.

### Types and Applications of Chemicals

Base chemicals also known as commodity chemicals, represented 60.4% of total EU chemical sales in 2018 and cover petrochemicals and their derivatives (polymers) along with basic inorganics.

- Specialty chemicals cover areas such as paints and inks, crop protection, dyes and pigments, and auxiliaries for industry.

- Consumer chemicals are sold to final consumers, The International Council of Chemical Associations estimates that over 95% of all manufactured goods rely on some form of industrial chemical process.

## Energy and GHG emissions

Energy use in the sector is characterized by the use of natural gas to generate steam or for direct heating, and the use of electricity for a range of activities, such as pumping, compression, chilling, and lighting. Regarding the gas energy consumption, i.e. the sum of natural and manufactured gas the reduction reached 30%. The most impressive reduction was the reduction of solid fossil fuels.


***Figure.1*** GHG emissions* in the EU chemical sector, millions of tons ($CO_2$ equivalent)

All this has led to a 55% reduction in energy intensity compared to 1991, characterizing the EU chemical sector as a pioneer in energy efficiency. Continuous efforts in terms of energy efficiency measures have already resulted in a decrease of total GHG emissions by 58% in 2017 compared to the 990 level, despite an expanded production of 78%, showing a decoupling of production vs. emissions

The most important chemicals that are considered as building blocks of chemical industry are:

**Methanol:** The specific energy consumption of the methanol process in Europe is at 12.5 GJ/t methanol, which mainly comprises fuel in the reformer, with 0.6 GJ/t of electricity use. Best practice technology level is around 9.8 GJ/t.

**Ethylene:** The specific energy consumption of Naphtha-based steam cracking is ~16.5 GJ/t.

**Chlorine:** The average electricity consumption of an electrolysis plant is ~3.3 MWh/ECU in 2010.

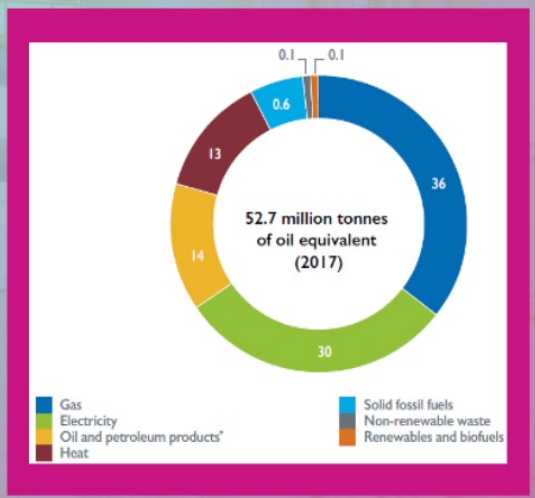


***Figure.2*** Total energy consumption* in the EU chemical industry by source

**Ammonia:** In 2020 fertilizer industry emitted around 35Mt $CO_2$ and ammonia was responsible for 30Mt. The European fertilizer industry's ammonia plants are among the most energy-efficient worldwide, with the lowest GHG emissions. "**Green ammonia**" will play a fundamental role in the decarbonization of the sector.

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## Decarbonisation potentials

Current and future technologies can sustain Europe's track record of energy and emissions intensity improvements: energy demand can be maintained constant, and emissions can be virtually eliminated with energy efficiency (33% of the total emissions reductions), $CO_2$ capture and storage (25%), renewable electricity (20%) and fuel switching and measures to reduce nitrous oxide emissions (22%). To enable continuous and competitive production, access to large amounts of reliable energy and feedstock will be necessary. Infrastructure will be crucial, including transmission grids for renewable power, pipelines for $H_2$, $CO_2$ and heat, waste logistics and recycling. Electrification of processes and new catalytic conversion routes can be listed as key options for a sustainable energy transition in this industry sector.

Further measures to reduce the carbon intensity of the used processes via efficiency measures may include incremental improvements, implementation of best practice technologies, i.e. production with plants at the highest available energy efficiency level, advanced heat integration and further advancements such as the use of process intensifying equipment.

## Fertilizer sector

Currently, the fertilizer association is representing 17 corporate members and 7 national organizations. It employs 74,000 people and has a turnover of € 9.5 BN. The EU production of fertilizers is relatively small with the total production to be reaching 16.8 Mt in 2019.

Around half of the fertilizers used are applied on cereals, 16% on grassland and 10% on oilseeds. The primary nutrients are nitrogen, phosphorus and potassium, followed by secondary nutrients calcium, magnesium and sulphur and other micronutrients (boron, cobalt, copper, iron, manganese, molybdenum and zinc), which can be incorporated into the major fertilizers or be supplied as speciality products. Each year, the European fertilizer industry transforms millions of tons of air, natural gas and mined ores into products based on the primary nutrients, ammonia being the building block of most fertilizers. The large $CO_2$ savings will come from the fertilizers that are produced in large volumes and their production is carbon intensive. The use of hydrogen in the production of ammonia and methanol is a game changer in the industry, following along with the use of biomass as feedstock.

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