Energy efficiency – key to defossilizing the chemical industry

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Abstract

Defossilization of the chemical industry is a big-ticket item in the redesign of the European (and non-European) industry. The chemical industry plays a key role in this endeavour, not the least since its large energy demand causes part of our industrial greenhouse gas emissions. On the other hand, society's hopes rest heavily on the chemical industry to develop technical solutions that help to save consumers´ greenhouse gas emissions, too.

For all these heavy-lifting tasks climate-friendly energy will be needed in very significant amounts. In the same moment, it is time to question the energy intensity of many of today's chemical processes. These processes originate from a period when energy was cheap, abundant and when no one would question the environmental burdens associated with its use.

The pathway into a more climate-friendly and, thus, energy-efficient future starts with an inventory of today's global energy use, its energy efficiency, and the consequences of the latter for global CO_2 emissions.

Three selection rules are identified that could inform the search for a future infrastructure with an improved energy efficiency and, thus, significantly decreased GHG emissions:

- Combustion processes for chemical conversion will be disincentivized as they implicate energetically "costly" routes between hydrocarbons and their respective, thermodynamically separated oxygenates, in particular carbon dioxide
- Beyond thermodynamic differences between their reactants and products combustion processes also imply the export of co-generated heat on large scale that must later be reintroduced into the material to rebuild it. This energy management is inevitably accompanied by significant heat losses that are costly in a world of renewable energy.
- Existing industrial infrastructure must be questioned and improved as to its energy losses in great detail to make it fit for a renewable future. For chemicals, this will imply significant interventions into the flow sheet of existing and of new-built plants.

To that end, energy intensity and efficiency will be discussed for steamcracking of ethane in detail.