Will responsible energy strategies involve combustion?

Katharina Kohse-Höinghaus,
Department of Chemistry, Bielefeld University, Germany

Increasing public concern about the carbon dioxide release from combustion of fossil fuels and recent emission scandals suggest that it may be time to phase out combustion. Combustion, however, is often mistaken as a synonym for the combustion engine in passenger cars, while the number of important current combustion applications is much larger. The global primary energy consumption today still relies to more than 80% on the combustion of fossil fuels. Decreasing the fossil share is the more challenging because of increasing population and rising energy demands, especially in emerging economies. Replacement strategies towards a renewable energy system must address the needs of the different energy sectors, with quite different system and process characteristics for electric power generation, transportation, low-temperature heat and high-temperature process energy. Aviation, long-range ground and sea transportation as well as large-scale industrial processes needing high-temperature heat (such as making glass, ceramics, steel and concrete, etc.), must be addressed as important parts of the intended transformation. It is useful in this context to analyze the demands and systems in terms of available alternative primary energy sources, the magnitude of energy needed, possible conversion processes and necessary infrastructures, as well as to devise efficient and productive transformation strategies and consider time scales for their introduction. The German "Energiewende" can serve as an illustrative background.

Towards a fully renewable perspective, it should be appreciated that combustion is a process that is not limited to fossil fuels, but can be applied to the use of alternative fuels such as hydrogen and other fuels that can be produced from renewable electric power or biomass. High-density liquid fuels will, for example, foreseeably remain to be needed for air transportation but might in the future be produced from non-fossil processes. Chemical energy carriers are well suited for energy storage and for conversion processes in a reliable energy system that adopts fluctuating renewable power sources. A vast amount of useful knowledge for the future is available from the present understanding of combustion technologies, regarding gaseous and liquid energy carriers, their behavior under the needed conditions of temperature and pressure, safety aspects for their handling and transport as well as the details of their reaction and conversion mechanisms that can be used to predict, integrate and optimize systems coupling renewable energy with chemical energy carriers.

Some theses were introduced for further discussion:

- There is no one-and-only, single path towards a sustainable, carbon-reduced energy system.
- Combustion (with high efficiency, different, C-neutral fuels, low emissions) will remain an important, integrated part of the energy portfolio.
- Organizing huge transformation processes (regarding systems, machinery, infrastructure, compliance) must allow for flexibility and adaptation.
- Solutions will need international (European) cooperation, coordination, standardization, regulation and legislation.
- Academia should strive to support acquisition of systems knowledge based on peer-reviewed, quality-controlled information for all and foster transdisciplinary, participative dialogue and exchange.