Global energy & emissions reduction potential of chemical process improvements and partial oxidation hurdles

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Introduction

More than 95% of all manufactured products rely on chemistry. To make these products that provide solutions across a wide array of applications, 90% of chemical processes employ catalysts to enhance production efficiency. Still the chemical industry is a large energy user, consuming 30% of global industrial energy, so catalysts and related energy efficiency improvements play an important role in sustainably employing the global energy supply.

A recent global chemical industry technology roadmap describes the potential impact of continuous improvements, best practices, emerging technologies, and breakthrough advances to cut energy use and emissions (greenhouse gases and other pollutants). Improving the efficiency of olefin production and alternative routes to feedstocks are among the top opportunities highlighted. In these areas, partial oxidation is one of the routes where discussion of the key catalytic and separations hurdles would be beneficial to advances.

Materials and Methods

Publically available data for catalyst impact on process efficiency is limited so this study combined information from several complimentary sources. Information on the energy consumption and catalyst impact for the top 40 energy consuming catalytically relevant processes was gathered using a questionnaire sent to chemical manufacturers, catalyst manufacturers, and academic experts. The survey responses were augmented/verified using market research data from IHS Consulting, contact with industry experts, and discussions with licensors. Open literature was also used to provide a broad perspective. To compare processes on a similar basis the specific energy consumption (SEC) was used. This is the amount of energy, expressed in GJ/, that an average plant would require to produce a specific product.

Results and Discussion

The roadmap focused on the energy and greenhouse gases (GHGs) emissions impact of the top 18 energy consuming chemical products that are catalytically relevant as they consume 80% of the energy in the industry and emit 75% of the GHGs. In **Figure 1** the five large-volume products shown in red text dominate the energy consumption landscape. While ethylene is primarily made by steam cracking today there has been progress on catalytic routes, including demonstration plants using catalysts for conversion of naphtha.

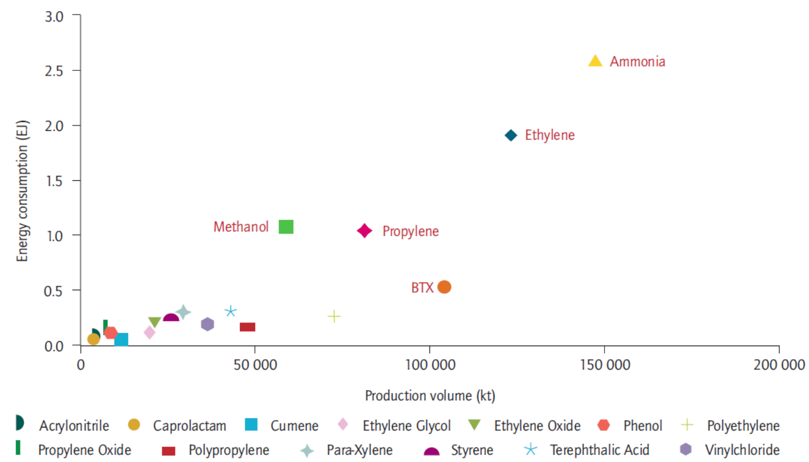

Figure 1. Global energy consumption vs. production for the top 18 large-volume chemicals.

Significance

Energy efficiency improvements in the production of these top products via all segments could save as much as 13 Exajoules (EJ) and 1 gigatonnes (Gt) of CO_2 equivalent per year by 2050. That's more primary energy than used by the country of Germany today. Achieving these deep energy and emissions cuts will require development and deployment of emerging technologies. Further step changes will require "game changers" that make sweeping changes in the way that these top products are made. It will also require a revival in R&D for catalysis and separations for top chemical processes.

Top opportunities and technology needs include feedstock production efficiency and alternative routes to olefins. Routes to simple alcohols such as partial oxidation remains a challenging area for advances in catalysis and downstream separations of reaction products. Identification of top hurdles to address these areas is an important part of the next steps. This talk will discuss several of these hurdles, current progress, and the potential for collaborative research to lower these hurdles.

References

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