Methanol-to-X, Fischer-Tropsch, e-fuels, SAF

A-125

From Oil to Low Carbon Carriers for Transportation and Chemical Production

M. Marchionna
Società Chimica Italiana, Division Industrial Chenistry, Milano, Italy

Abstract
The fossil fuels have provided about 80% of total energy consumption for more than 100 years. Looking ahead, although renewables are the energy source with the highest growth rate, fossil fuels will still play an important role, due to their higher energy density, their reliability and affordability, the ever-growing need for energy worldwide (furtherly exacerbated by AI adoption), and the high current exposure to these sources, not easily substitutable in the low-medium term. A few considerations, regarding the chain of production, transport and use of the energy carriers, make us easily realize that the success that Oil matured over the years as energy source cannot be attributed only to its great availability and the relatively cheap price but also to the ease with which liquid hydrocarbon derivatives can be transported, stored and distributed for their final use because of their optimal energy density per unit of volume. In addition, unlike most energy sources that are directed to electric power generation, oil production is mainly devoted to the transportation market and a significant minor part to petrochemistry.

Of course, the effects on the environment are relevant and make Oil less appealing, especially in the longer term, calling for the identification of less emitting substitutes but with the same peculiar properties; consequently a huge effort is being devoted worldwide to develop several innovative decarbonized energy/carbon carriers which may constitute the base for achieving sustainable low-carbon fuels and are key to decarbonize chemical productions. Among them, a few alternative synthetic carriers, such as hydrogen/ammonia and alcohols (methanol, ethanol and even butanols) or derived ethers (dimethyl ether - DME) are increasingly attractive.
In this respect, particular attention will be given in the presentation to the alcohols, key intermediates for Sustainable Aviation Fuels (SAF) and possible base for more decarbonized petrochemistry (or carbo-chemistry).
On one side, within the SAF landscape, Alcohol-to-Jet (ATJ) is an emerging pathway positioned as early commercial scale, offering high feedstock flexibility and compliance with aviation fuel specifications. On the other hand, the use of bio-ethanol as the raw material for producing ethylene and, ultimately, as a possible key intermediate for the industrial organic chemistry of the next decades will be discussed. A similar result could be achieved through low carbon methanol (or DME), although with different conversion processes.

Coming back to Oil, in perspective, it will be less dominant in mobility, but it will remain still central to the petrochemical industry, as also shown by new projects in Middle East (especially Saudi Arabia) for the direct conversion of crude oil into petrochemical derivatives.