Some years ago, Prince Turki Al Faisal, Saudi Arabia’s former Ambassador to the United Kingdom, and also to the United States, noted, “…There is no way that people, whether in the United States or in the world, that consume oil would simply give up using oil in the next few decades at least, if not more than that ..” This salutary statement highlights the fact that as humankind’s present dependence on fossil fuels continues – surely for the foreseeable future and indeed beyond – and as our demand for energy inevitably increases, so will emissions of greenhouse gases, most notably carbon dioxide (CO₂).

To avoid the obvious consequences on climate change, the concentration of such greenhouse gases in the atmosphere must be stabilized. But, as populations grow and economies develop, future demands now ensure that energy will be one of the defining issues of this century. This unique set of (coupled) challenges also means that science and engineering have a unique opportunity—and a burgeoning challenge—to apply their understanding to advance realistic energy solutions. Integrated Carbon Capture and Storage (CCS) is generally advanced as the most promising option to tackle greenhouse gases in the short to medium term. Here, we provide a brief overview of an alternative mid- to long-term option; namely, Carbon Capture and Conversion (CCC) or equivalently Carbon Capture and Utilisation (CCU) to produce carbon-neutral, synthetic hydrocarbon or carbonaceous fuels, most notably for transportation purposes. Basically, the approach centers on the attractive – but highly challenging - concept of the large-scale re-use of CO₂ released by human activity to produce synthetic fuels, and how such an approach could assume an important role in tackling the issue of global CO₂ emissions.

We highlight three possible strategies involving CO₂ conversion by physico-chemical approaches: sustainable (or renewable) synthetic methanol, syngas production derived
from flue gases from coal-, gas- or oil-fired electric power stations, and photochemical production of synthetic fuels. The use of CO₂ to synthesize commodity chemicals is covered elsewhere [1]; In a recent article [2] we have focused on the possibilities for the conversion of CO₂ to fuels. Although these three prototypical areas differ in their ultimate applications, the underpinning thermodynamic considerations centre on the conversion—and hence the utilization—of CO₂. Here, we hope to illustrate that advances in the science and engineering of materials are critical for these new energy technologies, and specific examples are given for all three examples. With sufficient advances, and institutional and political support, such scientific and technological innovations could help to regulate/stabilize the CO₂ levels in the atmosphere and thereby extend the use of fossil-fuel-derived feedstocks.

References: