Fossil fuels: to burn, or not to burn – that is the question

PETER EDWARDS

Global energy demand will double by 2050. Hydrocarbon fossil fuels will provide the overwhelming majority of that energy as they remain the cheapest, most efficient and most flexible source of large scale energy for both the developed and the developing world. It is no exaggeration to say that our entire industrial society is based on the heat emitted when fossil fuels are burnt through the chemical reactions $C + O_2 = CO_2$ and $H_2 + O = H_2O$.

However, over 100 years ago, the Nobel Prize-winning chemist Svante Arrhenius calculated, using established and well-understood physical concepts, that CO_2 emissions from fossil fuel combustion would ultimately lead to global warming. He thereby laid the foundations of modern climate change research. This year marks another milestone in the accumulation of anthropogenically produced CO_2 in the atmosphere, now reaching 400 parts per million; perhaps even more worrying is the rate of accumulation of CO_2 which also continues to rise.

Alternative, renewable energy sources are advanced as the solution to anthropogenic emissions. They are sometimes mooted to appear far more ready than realistic for widespread replacement of huge volumes of fossil energy sources. The truth is that fossil fuels – much maligned in many quarters – will remain vital for our development, prosperity and indeed our survival for many decades into the future. There is thus a world of difference between developing more effective and efficient use of fossil fuels and abandoning them altogether. So, the question should be posed "*Can we help save the world from climate change by reducing the amount of CO_2 emissions through clean energy from fossil fuels*?"

One avenue – again acquiring prominence – is Carbon Capture and Storage (CCS), which involves the capture and sequestration of CO_2 from fossil fuel power plants in underground or under sea repositories. CCS may well be part of the solution although there are continuing concerns relating to the cost (energy and price) of CCS together with social concerns about burying huge concentrations of CO_2 underground.

A new initiative coupling Oxford with colleagues in Saudi Arabia, China, India and the USA is an innovative approach to carbon sequestration in which CO_2 never enters the atmosphere. Hydrocarbon fossil fuels are not burnt, but rather used to generate high purity hydrogen in vast quantities through their "dehydrogenation" by catalysts. Hydrogen is then used in fuel cells to produce electricity and the other product, solid carbon, is recycled to fuels using established chemical routes.

It is a sobering thought that all the world-wide furious activities associated with extraction, transportation and deployment of fossil fuels has its ultimate fulfilment in their destruction by combustion – conflagration – with the attendant ever-increasing CO_2 problem. A new scientific and technological era of "*Fossil fuel decarbonisation*" beckons, where we will not burn fossil fuels for power, but rather utilise them to produce hydrogen as the new and abundant renewable energy carrier.

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