

## CHALLENGES AND OPPORTUNITIES FOR FOSSIL FUELS IN A CARBON-CONSTRAINED WORLD – AN AUSTRALIAN PERSPECTIVE

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With climate change undeniable, what are Australia's opportunities for achieving more controlled greenhouse gases releases, while still using fossil fuels?

How does this interplay with the reduction of fossil crude oil supply and the increasing shift in Australia towards importing finished products, declining refinery infrastructure and consequently reduction in the availability of chemical feedstocks for the local chemical industry? In fact, will there be an Australian chemicals and refining industry 30 years from now?

The talk discussed these questions and aimed to outline a vision for Australia that might successfully deal with some of their aspects. Furthermore, this vision will be partially translated and exemplified with our lignite value-add project in Victoria.

To illustrate some of the thinking, our Catalytic Hydrothermal Reactor (Cat-HTR) breakthrough technology was introduced and discussed conceptually in terms of some of the underlying science and technology. Low-rank coals (e.g. brown coal/lignite) as well as biomass (e.g. forestry waste or algae) can be converted into high-quality syncrude oils which are suitable for refining in conventional or dedicated oil upgrading facilities.

In the case of lignite, not only synthetic crude oil but also high-quality coals (32 MJ/kg) are produced, starting from an as-mined feedstock with a very low energy density of around 9 MJ/kg. This allows for a complete re-think of

how to use brown coal, opening efficiencies of conversion towards 60% (as compared with current brown coal usage efficiencies of around 18%).

The syncrudes that are produced have energy contents from around 36 MJ/kg (biomass-derived) up to 39 MJ/kg (lignite-derived). Testing by third-party European contractors, using commercially available catalysts and standard industrial petrochemical testing equipment, has shown that they can be co-processed with conventional fossil oil feedstocks to 'drop-in' diesel, gasoline and aviation fuel. It is noteworthy that heteroatoms such as sulphur, organic nitrogen and oxygen are readily removed from these syncrudes under conventional hydrotreating process conditions enabling, for example, the production of diesel that meets ultra-low-sulphur specifications and jet fuel type fractions with very low cloud points (-61°C).

The novel Cat-HTR technology is based on processing under near-supercritical water conditions in the presence of proprietary catalysts. The technology has been demonstrated in a continuous-flow pilot plant for some five years and has proven to be robust, versatile and scalable. The first near-commercial demonstration plant (10,000 tpa name-plate capacity) in Somersby (near Newcastle) was opened in December 2012 by Martin Ferguson, then Federal Minister for Resources, Energy and Tourism. The next level scale-up was shown during the lecture.