Rapid developments are currently taking place in the area of petroleum-based fuels blended with Fischer-Tropsch (F-T) components and commercial approval is expected for some blends. There are also bio-derived jet fuel efforts in both the US and EU. However, a very limited amount of detailed data is currently available for F-T fuels and oxygenated compounds typically present even greater challenges and appropriate fuel specifications remain to be agreed. For both fuel families there is a distinct need to develop a comprehensive technology base that can support the development and optimization of propulsion devices. In terms of environmental emissions, it is becoming evident that, for example, different bio-derived fuels have different potentials to reduce particulate emissions depending on their chemical structure. Fischer-Tropsch based fuels also exhibit significantly different sooting propensities as compared to petroleum-derived fuels. In other application areas, the ignition characteristics of a fuel become of particular importance and, again, emerging fuels can show significantly different behaviour as compared to current alternatives. The highlighted issues can typically be expected to become more prevalent and of greater significance for combustion devices operating closer to stability limits where the sensitivity to the fuel chemistry can be expected to increase. Such conditions are often a direct consequence of a desire to reduce fuel burn and to lower combustion temperatures in order to reduce emissions. A proper representation of the fuel chemistry and the encapsulation of that understanding into calculations methods that are useful for design purposes is becoming a prerequisite even for the optimization of current engines operating on conventional fuels. The need for a significant research effort in this area is further emphasised by the fact that the results serve as a basis for the extension to the new fuel families. The talk will provide an overview of the emerging challenges associated with likely changes in fuels and operating conditions against a backdrop of current concerns with pollutants such as oxides of nitrogen and particulates. The talk will also cover potential new combustion regimes and the implications for calculations methods.