STATUS OF DME AS AN ALTERNATIVE FUEL

I first came across the use of Dimethyl Ether (DME) as an alternative fuel for power generation back in the mid 1990s. As an independent consultant I was approached by AMOCO for leads to where they might source gas for DME. Their concept was to produce DME in Australia and export this as a power station fuel to potentially new generating facilities in the Far East. The driver for this was the imminent burgeoning demand for power in the Tiger economies coupled with the fuel that offered certain advantages over LNG, namely a lower capital cost of entry, easier to store and transport in smaller packets, does not require major re-gasification facilities and was a proven fuel in gas turbine operations with lower NOx emissions than gas.

After AMOCO was taken over by BP the concept died as the merged company focussed on LNG developments including the development of LNG from the large gas discovery in West Papua (in Indonesia) made by ARCO which was taken over by BP in the same period.

In recent years the potential for the mass production of DME has emerged and is being progressed by several organisations. This has been spurred by the mass production of DME in China where it is blended with LPG. Here I give an overview of DME and its potential use as an alternative fuel.

The properties of DME and methanol compared with conventional liquid fuels is shown in Table 1.

Table 1: Properties of fuels of interest

		Methanol	DME	Propane	Butane	Gasoline	Diesel
Boiling Point	^oC	65	-25	-43.7	-0.5	30-190	230-360
Flash point	^oC	11	-41	-104	-60	-43	>63
Specific volume	L/t	1278	1493	1998	1928	1360	1182
Higher Heating Value	GJ/t	22.7	31	50.33	49.45	46.7	45.9
Lower Heating Value	GJ/t	19.5	28	46.36	45.67	42.5	43.0
Research Octane No.		100	<20	110	96	90-100	
Cetane No.		<10	55	<10			45-55

The Table shows that the physical properties of DME are similar to propane and butane the components of LPG for which it can be substituted. However, although the heating value is higher than methanol it is lower than the hydrocarbon fuels. Thus when substituting for LPG, a larger quantity is required for the same output (1.58 tonnes of DME is equivalent to 1 tonne of propane). Experience indicates that up to 20% of an LPG stream can be substituted with DME without requiring changes to burners etc. The lower heating value, as a consequence of the inclusion of oxygen in the molecule, delivers lower flame temperature which results in lower nitrogen oxide emissions (NOx) in the exhaust gas.

Unlike methanol, the Research Octane Number (RON) is low and is therefore unsuitable for spark ignition engines (petrol) but conversely the cetane number is much better which makes it a suitable substitute for compression ignition engines (diesel).

The good cetane value and clean burning properties of DME has made it the focus of research and demonstration activities for many years as a potential diesel alternative. Notable in this work was sponsorship by MITI in Japan who have been at the forefront of promoting the use of DME for this role.

For diesel substitution the vehicle requires little more than a storage vessel and a suitably modified injection system. However, like other alternative fuels, penetration of the diesel market is relatively slow. DME as an alternative fuel does not attract the cash subsidies and regulated demand available to the producers of agricultural based alternatives – ethanol and biodiesel – which drives the penetration of these alternative fuels into the fuels market.

The current principal driver is the use of DME as an LPG substitute. Substitution of LPG is attractive to countries which have a large domestic demand for LPG but no indigenous source. Since the LPG price is determined by the prevailing crude oil price, LPG import costs are subject to price volatility in the oil market. DME is made from methanol which in turn is made from coal or natural gas, so countries that have indigenous supplies of coal or gas can protect domestic consumers from price volatility and ease balance of payments by this substitution. This is the principal driver for large scale DME production in China, developing projects in Egypt and proposed developments in Indonesia.

For the effective substitution of DME for conventional fuels, DME has to be produced from low cost coal or gas. Figure 1 shows a fixed variable cost estimate for a typical large scale project (610,000 t/y DME) with the production cost of DME given in $/GJ on a lower heating value basis. For comparison Figure 2 shows the historical trend for gas oil (diesel) and Figure 3 the Aramco contract price of propane, again plotted in energy terms.

Figure 1

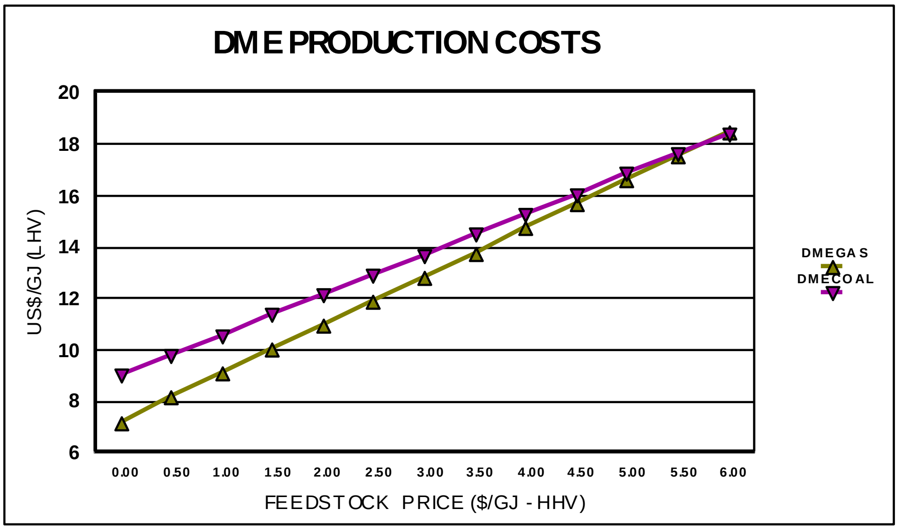


Figure 2

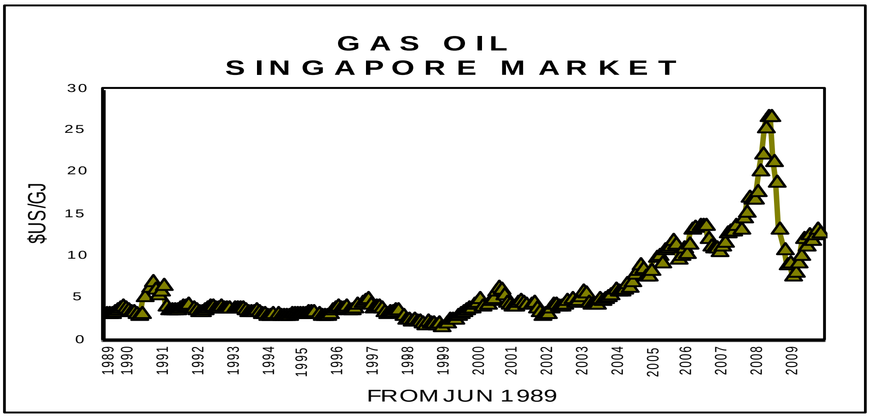
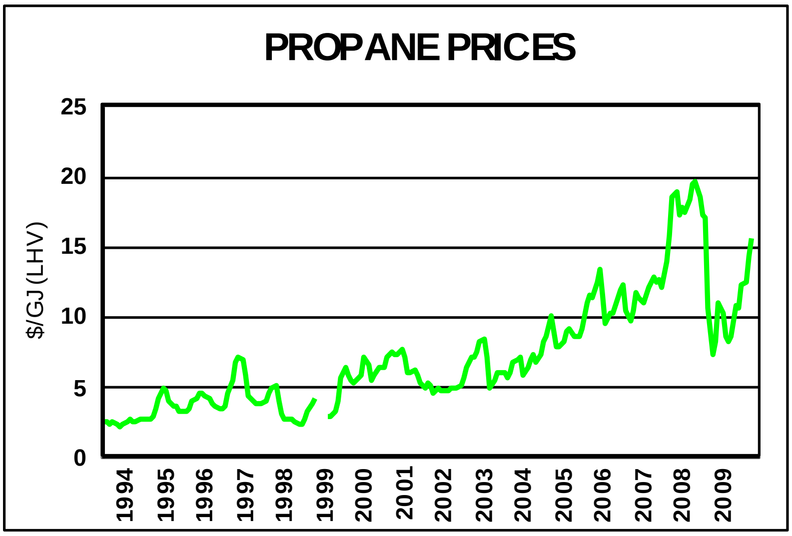


Figure 3



This data shows that prior to about 2005 both gas oil and propane was valued below $5/GJ. The production cost estimate for DME shows that DME could not be produced at this price level for any reasonable price of coal or gas feedstock. However, since 2005, the cost of gas oil and propane has more than doubled and both usually sell at a price higher than $10 to 12/GJ. The DME cost of production estimate indicates that DME can be produced at these prices with coal below $1/GJ (or about $20/tonne) and with gas below about $2/GJ. Energy prices in this range are widely available across the world from large scale open cut coal mining or in large uncommitted gas reserves.

In Australia, coal is widely available at production costs below $1/GJ. DME could be produced as either an LPG or a diesel substitute for either transport fuels or a generating fuel in standing diesel engines or in gas turbine generators. The downside is that, like all other energy transformations, large amounts of carbon dioxide will be produced – about 650,000 tonnes/year from the project considered here. As a nation we seem to have decided that these technologies and innovations are for others as we attempt to “decarbonise” or economy. We therefore seem destined to remain observers of these developments elsewhere.

D SEDDON 16/02/2010