

CHEMICAL ECONOMICS - FUEL, CHEMICAL AND COMMODITY PRICES

We live in a world where the prices of many products required for everyday life are influenced by the prevailing price of crude oil. Crude oil is the basic building material for the production of transport fuels and chemicals. In urbanised economies such as ours, transport fuel prices have a significant influence on the cost of food by impacting on the farming, fertilizers, harvesting and transport to markets. Crude oil produces the basic materials for the production of commodity plastics (for rigid consumable items as well as packaging) and synthetic fibres (polyester, nylon, spandex (Lycra™) and Kevlar™) to produce clothing which cannot be produced from natural fibres.

The cost of fuels and chemicals is very dependent on the prevailing price of crude oil. The major portion of crude oil is traded on the spot market. For transport fuels the cost is direct and almost instantaneous in that changes in the price of crude oil results in changes to fuels within a few days and sometimes within hours. For example the cost of petrol shows a strong correlation with the price of crude oil.

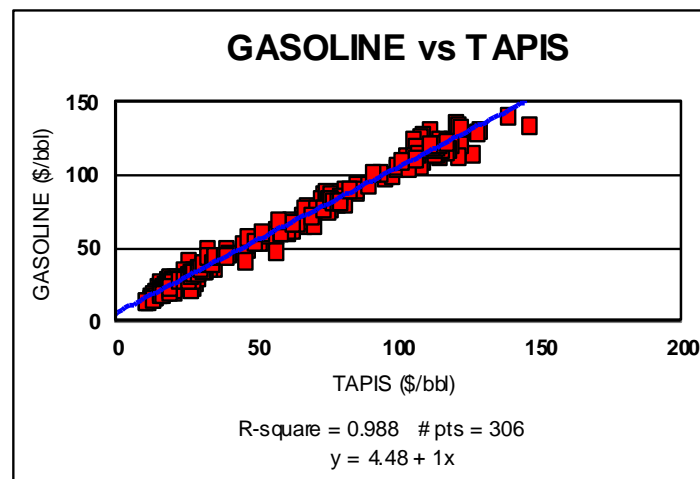


Figure 1: Correlation of the price of gasoline (petrol) and Tapis Blend crude oil on the Singapore spot market

The figure shows a very strong correlation for gasoline (petrol) with Tapis crude oil traded on the Singapore market. A rise and fall in the price of Tapis produces a commensurate effect in Australia about a week later due to the material hold-up in the delivery chain.

For chemicals, the cost of production is determined by the cost of the feedstock (oil price related) and other factors which influence the final production cost. These factors are the cost of the capital for the production facility and the operating cost of the plant (labour, maintenance, other chemicals and catalysts that may be required, insurance etc.). Although chemical processes are capital intensive, for most chemicals the dominant cost is that of the feedstock and hence production cost is related to the price of oil.

However the price paid for chemicals which are used in the economy at large, other factors come into play. These encompass the general state of business (the business cycle), the relative availability of the product (shortages and gluts) which may have location specific factors, for instance the

presence in a locality of a dominant supplier. Thus as the price of crude oil rises and falls, so does the level of the price of chemicals, but the correlation is far lower than that observed for crude oil derivatives such as transport fuels - gasoline (petrol) and diesel fuel.

Although there are regional difference in price which can be exploited by traders and suppliers, transport logistics are now very efficient so that there is little persistent difference in the cost of chemical products across the world, especially solid goods that can be shipped in containers (e.g. commodity polymers) or large bulk carriers (e.g. fertilizer).

Starting from crude oil producing a final product selling into the economy at large can involve several intermediates. The chain of materials from oil to product involves increasing added value. This value chain is illustrated for polyester in Figure 2.

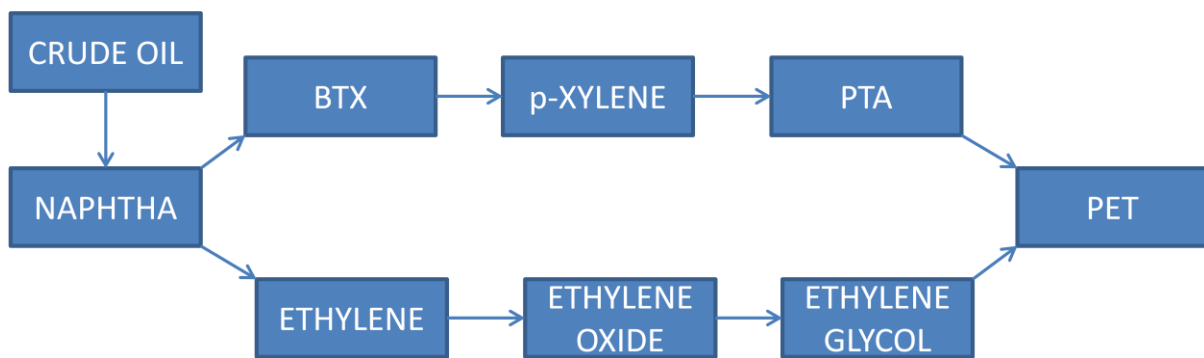


Figure 2: Value chain for the production of polyester (PET) from crude oil.

Crude oil is first distilled to produce the naphtha fraction which is used to produce ethylene (by steam cracking) and aromatics (BTX, by reforming). The aromatics intermediate (BTX) is used to produce *para*-xylene which is then oxidised to *para*-teraphthallic acid (PTA). The ethylene fraction is oxidised to ethylene oxide which is then hydrated to produce mono ethylene glycol (MEG). The PTA and the MEG are then reacted to produce the polyester polyethylene teraphthallate (PET). This is then sold to the final users to produce yarn, sheets or bottles.

Large integrated petrochemical complexes perform all this chemistry from crude oil to PET which is sold to downstream customers. However, all of the intermediates are bought and sold on the chemicals market so there are opportunities to enter this value chain at any stage from suppliers with excess material or specialising in producing any one of the intermediates.

This is the case for bio-chemical producers who can enter the value chain for PET by producing MEG from bio-ethylene produced by dehydrating ethanol which has been produced from renewable sources. Entirely bio-PET is still a problem because renewable routes to aromatics or PTA are not well defined and well away from commercialisation. There has been an enormous surge in research into the production of bio-PET, thanks mainly to announcements by *The Coca Cola Company* that they would like their products to be available in renewable containers.

There are several approaches to produce bio-aromatics, none of which very well defined at the present. One is to use bio-ethylene as the feedstock for producing aromatics by oligomerising the ethylene followed by conversion over a zeolite catalyst to an aromatic. Another is to use a C4-species such as succinic acid produced by glucose fermentation, which is used to produce a bio-butadiene which is subsequently coupled to produce *para*-xylene. Another proposal is to produce carbon monoxide and hydrogen by gasification of biomass which is then converted via methanol to aromatics.

As we know, PET bottles are collected for recycling and there is a large and growing trade in recycled- PET (R-PET) especially in the larger economies. R-PET enters the value chain at the very end but interesting most R-PET is used to produce fibre or sheeting rather than recycled into bottles.

Since the beginning of 2015 we have witnessed a major fall in the value of crude oil and this is leading into price falls in the chemicals sector. This price fall is making it more difficult for producers of renewable and recycled materials to enter the value chain because their feedstock have generally not fallen in value as much as that of crude oil. We may witness a marked slowing of entrants into the renewable and recyclable chemicals sectors as their price premiums relative to conventional fossil fuel derived products are squeezed.

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