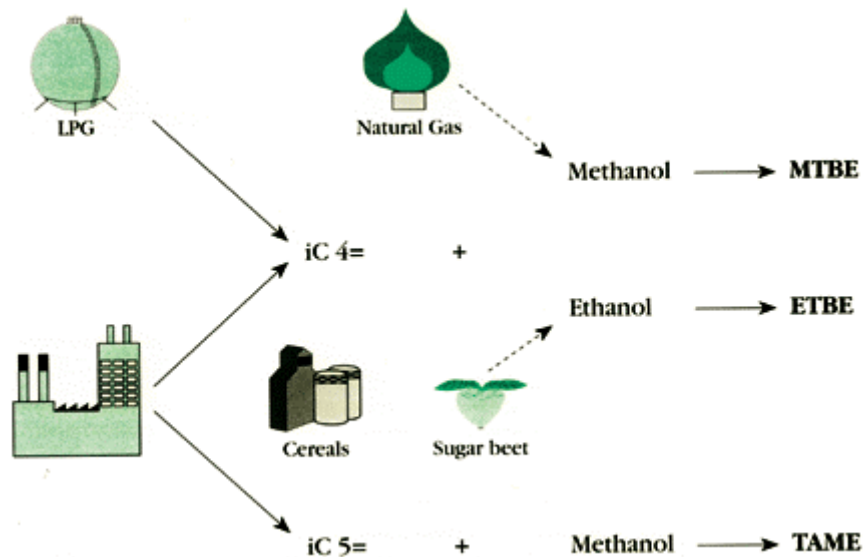


## MTBE Supply, Demand & Industry Outlook

### Supply

Oxygenates can be produced from both petrochemical and agricultural feedstocks. Methanol, derived primarily from natural gas, is one feedstock used in the production of methyl tertiary butyl ether (MTBE). Ethanol, derived by a fermenting process from corn and other agricultural products, is used either directly as a fuel additive, or as a feedstock for the production of ethyl tertiary butyl ether (ETBE). Isobutylene, which is the other feedstock used in both MTBE and ETBE production, is also derived from natural gas, or as a by-product of petroleum refining.

Production facilities are typically located near feedstock supplies. These may either be in a refinery with butylene from the fluid catalytic unit, or combined with the butylene by-product of a steam cracker. Large-scale MTBE units are based on butane isomerisation/dehydrogenation technology, where both the butane and the methanol are derived from gas sources of low alternative value.



MTBE is the most widely produced oxygenate. Its raw materials are isobutylene and methanol. An important reason for the widespread use of MTBE is feedstock flexibility. MTBE can be made inside the refinery, using petroleum-derived raw materials, or it can be produced externally, using natural gas feedstocks, thereby ensuring ready availability and reducing dependence on crude oil for the production of automotive fuels.

Isobutylene can be obtained from:

1. steam cracker operation
2. fluid catalytic cracker (FCC) operation
3. butane dehydrogenation
4. dehydration of tertiary butyl alcohol

#### 1. Steam cracker

Steam cracker operations produce isobutylene cost-effectively, but availability is limited. Only a small percentage of the cracker feed is converted into a C4 fraction, the main products being ethylene and propylene. Most of the contained butadiene is extracted and the remaining raffinate-1 is an important source of isobutylene. The premium uses for isobutylene are isobutyl rubber and polyisobutylenes, but it is also an intermediate for a wide range of

specialty chemicals. The remainder is mainly used as MTBE feedstock.

More recent technologies convert other C4 components into isobutylene. Notable are the partial hydrogenation of butadiene and the skeletal isomerisation of normal butylenes.

## 2. FCC

FCC off gases are another source of isobutylene. With the continued requirement for upgrading heavy refinery fractions, more isobutylene is becoming available from this source and a logical use for this stream is an onsite MTBE unit. In Europe there are about fourteen such refinery MTBE units.

## 3. Butane dehydrogenation

The dehydrogenation route is very capital intensive. Normal-butane needs to be isomerised into isobutane, which is then dehydrogenated into isobutylene. The capital investment for a grassroots 700 kilotonnes/year unit is about 500 million dollars. Most of the current dehydrogenation units are built in areas where infrastructure is already available or in places where raw materials are available at low costs, e.g. the U.S. Gulf Coast, Saudi Arabia, Canada, Malaysia.

## 4. TBA

Tertiary butyl alcohol (TBA) is produced as a co-product of propylene oxide in dedicated plants. TBA is dehydrated into isobutylene to produce MTBE. It can also be sold directly as an octane-enhancing component for gasoline. Dehydration of TBA is a very cost-effective method of producing MTBE in large quantities.

### *Production capacity*

Commercial production of MTBE started in Europe in 1973 and in the US in 1979. Total worldwide production capacity in 1998 was 23.5 million tonnes and the actual production was 18 million tonnes. The estimated annual production of MTBE in the EU today is 3 million tonnes.

### **Demand**

Over the past decade, MTBE demand worldwide has experienced rapid growth, but has now stabilised.

In 1998, world consumption was approximately 19.5 million tonnes, about double that of 1992, representing an annual growth rate of about 12%. The driving force for this growth was the US Clean Air Act. Present trends indicate a mild growth in 2000, up to 20 million tons, with US consumption slightly declining and other parts of the world growing.

In Europe, the demand is today approximately equal to the production capacity, i.e. around 3 million tonnes. In the last few years Europe was a net exporter of MTBE (either as a straight component or blended into gasoline), but the implementation of stricter gasoline quality requirements has recently increased the demand for alternative high octane blending components. The consumption of MTBE is expected to remain fairly stable in Europe over the next few years