ETHYLENE GLYCOL EUROPE

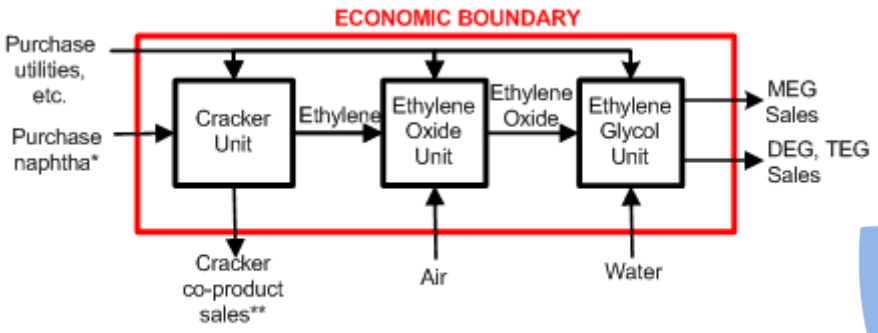
ICIS Weekly Margin – Ethylene Glycol (EG) Europe Methodology

This document is intended to provide methodology support for customers receiving the ICIS Weekly Margin – EG Europe report. Please note that the margin measured is that for monoethylene glycol (MEG), with the higher molecular weight glycols considered as co-products.

THE BUSINESS MODEL

The simplified diagram below shows the main method of making mono ethylene glycol (MEG) from naphtha, a product mainly derived from crude oil. Naphtha with steam is fed into a cracker unit where ethylene and other co-products (such as propylene, butadiene, benzene, etc.) are made. The ethylene from the cracker unit is separated from the co-products and processed with oxygen to make ethylene oxide which is then hydrolysed to produce MEG and higher molecular weight glycols including diethylene glycol (DEG) and triethylene glycol (TEG). The cracker co-products are also separated and sold for use in other chemical plants or used for fuel

A simplified illustration of material flows is as follows:



*Naphtha is the dominant cracker feedstock in Europe
** includes propylene, butadiene, raffinate-1, fuel gas, benzene, gasoline blending components

The margin calculation

Margin measure provides assessment of the ex-works cash margin obtained for the product over raw material costs and key variable manufacturing costs such as power and steam. This measure can also be termed as a variable margin, contribution or benefit.

It represents a cash margin measure available for supporting the direct and allocated fixed manufacturing costs, working capital, taxes, royalties, corporate costs, debt service costs, capital costs and owner's returns from the business.

This margin measure provides simple signals on the direction of business margins, as dictated by the environment alone, thus informing market positioning by sellers, buyers and traders.

ICIS chooses not to model beyond raw material costs and key variable manufacturing costs as this ceases to be generic to the industry and highly specific to individual business operations, their site structure, location, ownership and financial structures. Such detail would not fairly reflect or be applicable in a wider industry context. It may also be more subjective, open to fair challenges and not feasible to reference in commercial discussions.

Plant manufacturing and feedstock yield model data for the cracker unit have been provided by Linde Engineering division, a part of Linde AG. Linde Engineering (www.linde-engineering.com) is a leading international chemical plant designer, process engineering, procurement and construction contractor. It has extensive experience in ethylene plant design.
Yield model data for the oxygen requirement and cost of oxygen calculations, including allowance for a monthly fixed fee to a third party onsite industrial gases supplier, have been provided by industrial gas consultants, Esprit Associates (www.espritassociates.com).

The process model is generic and not referenced to any individual operation, so that the contribution measure is only indicative. It can be most valuably referenced in index and step change terms as opposed to absolute value terms.

Naphtha feedstock has been chosen as this represents the most commonly used feedstock for ethylene manufacture in Europe. As such, the cost model is broadly applicable to the majority of the European commodity MEG business.

Ex-works product price assessments are linked to ICIS pricing quotations for large volume commodity products with netbacks assessed using typical logistic cost assessments.

Below is a detailed calculation of how the MEG margin is calculated. The figures refer to averages for contract sales values for 2010; the calculation for spot sales values is similar. Figures indicated in red are those found in the tables of the margin report; others relate to underlying assumptions of the model.

MEG margin calculation - averaged for 2010

Integrated margin	**€/tonne MEG**	
MEG contract price	840	
Logistics costs/netbacks	(166)	
Net selling price		674
Purchase feedstock (naphtha)[1]	(1143)	
Oxygen	(21)	
Co-product sales/tonne of MEG produced[2,3]	912	
Variable cost of EO/MEG unit[4]	(125)	
		(377)
Integrated margin		*297*

Standalone margin	**€/tonne MEG**	
MEG contract price	840	
Logistics costs/netbacks	(166)	
Net selling price		674

Ethylene contract price	(951)		
Freight/terminalling saving for not exporting	91		
Net ethylene price paid	(860)		
Net ethylene price /tonne MEG produced[3] ie purchase feedstock (ethylene)		(555)	
Purchase oxygen/tonne of MEG produced		(21)	
Co-product value of DEG/TEG/tonne of MEG produced		96	
Variable cost of EO/MEG unit[4]		(125)	
			(605)
Standalone margin			*69*

[1]The model assumes 3.278 tonnes of naphtha are required to produce 1 tonne of ethylene and 0.645 tonnes of oxygen are required to produce 1 tonne of MEG. The average net naphtha price (including freight costs) for 2010 was $714/tonne (with an average $:€ conversion rate of 1.33.

[2]Co-product sales include credits for propylene, butadiene, raffinate-1, benzene, pygas and a fuel export balance from the cracker and credits for DEG and TEG from the MEG unit.

[3]The model assumes 0.645 tonnes of ethylene and 0.67 tonnes of oxygen are required to produce 1 tonne of MEG.

[4]Includes power for the EO and hydrolysis to MEG.

DIFFERENCE BETWEEN INTEGRATED AND NON-INTEGRATED

ANALYSIS

- Non-integrated or standalone: Market participant involved with MEG production only. The business model is to buy ethylene, convert it into MEG and sell the MEG, DEG and TEG. This business model is only applicable to a minority of manufacturing facilities in Europe.~

- Integrated: Market participant involved with both ethylene and MEG production. The business model is to buy naphtha feedstock, process it to ethylene and cracker co-products, convert the ethylene into MEG, and sell both the MEG, DEG and TEG and the cracker co-products. This business model is applicable to the majority of manufacturing facilities in Europe.

WHY INTEGRATED ANALYSIS

- Integrated analysis provides the key reason for being (or 'raison d'être') in the commodity MEG business.
- Most West European MEG plants are integrated back to cracker sources of ethylene. This may be co-located and/or connected by pipe and with common equity ownership across both assets in the supply chain, i.e. the economic boundaries for the majority of the industry producers are bigger than a standalone unit.
- The margin is therefore measured across the supply chain from cracker feedstock (i.e. naphtha) through to MEG, DEG, TEG and cracker co-products.
- This analysis demonstrates the volatility of the business and the influence of price floors that can lead to an uneconomic integrated margin, and generally forcing a reduction in supply.

WHY NON-INTEGRATED ANALYSIS

- A non-integrated or standalone analysis that considers the MEG unit in isolation may be useful for understanding marginal opportunities where optimisation processes could result in ethylene being preferentially used for other ethylene derivative products. However, analysis of non-integrated historical data does show inadequate margins to justify fresh business investment to meet growing market demands.

MODEL YIELD PATTERN AND CALCULATION

- Plant manufacturing data relates to the variable cost components of the chemical unit operations. Yield pattern data relates to the overall material balance of the cracker unit, for example, for 1 tonne of ethylene produced, a cracker requires 3.2 tonnes of naphtha feedstock, and will produce co-products (including, but not limited to, propylene, butadiene, benzene) of 2.2 tonnes in addition to the 1 tonne of ethylene.

This plant manufacturing and feedstock yield model data for the cracker have been provided by Linde Engineering, a division of Linde AG. Yield model data for the oxygen requirement has been provided by industrial gas consultants, Esprit Associates.

The exact yield pattern used cannot be published in an unrestricted document such as this methodology statement. However, for ICIS Weekly Margin – EG Europe report subscribers with a specific requirement to see this data, it can be shared on a case-by-case basis.

Please contact the Global ICIS Customer Support Centre if this data is required.

ASSESSMENT INPUTS

The following pricing inputs are used to generate the full content of the ICIS Weekly Margin – EG Europe report

- Mono ethylene glycol in Europe monthly contract FD NWE [from July 2003, previously quarterly] (€/tonne)
- Mono ethylene glycol in Europe spot CIF NWE T2 [from 17 January 2003, previously mono ethylene glycol in Europe spot FCA Rotterdam] (€/tonne)
- Diethylene glycol in Europe spot CIF ARA [from 9 January 2004, previously Diethylene glycol in Europe spot FOB Rotterdam T2 ($/tonne)](€/tonne)
- Diethylene glycol in Europe spot FD NWE (€/tonne)
- Naphtha in Europe spot CIF NWE (Friday assessment) ($/tonne)
- Gasoline: unleaded premium in Europe spot FOB barges ARA (weekly average) ($/tonne)
- Fuel oil 1% in Europe spot CIF cargoes NWE (weekly average) ($/tonne)
- Ethylene in Europe monthly contract FD NWE [from January 2009, previously quarterly](€/tonne)
- Ethylene in Europe spot CIF NWE ($/tonne)

- Propylene in Europe monthly contract FD NWE [from January 2009, previously quarterly (€/tonne)
- Propylene (polymer grade) in Europe spot CIF NWE (€/tonne)
- Butadiene in Europe monthly contract FD NWE [from January 2011, previously quarterly](€/tonne)
- Butadiene in Europe spot FOB Rotterdam ($/tonne)
- Benzene in Europe monthly contract FOB NWE [from January 2004, previously quarterly] (€/tonne)
- Benzene in Europe spot CIF ARA ($/tonne)
- Raffinate-1 in Europe spot CIF NWE ($/tonne)

Oxygen is valued in energy terms, with 1 tonne of oxygen considered to be equivalent to 0.116 tonnes of fuel oil and 0.67 tonnes of oxygen required per tonne of MEG produced. The model assumes oxygen is supplied under long-term contract from an onsite industrial gases unit, owned and operated by a third party. A fixed monthly fee payable to the industrial gases supplier, to cover both the variable costs of operation of the industrial gases unit and its capital costs, is allowed for within the variable costs per tonne of MEG produced.

The ICIS pricing methodology associated with each individual pricing quotation referenced above can be found in the free access methodology area ofwww.icispricing.com
In addition to the above pricing inputs ICIS pricing uses the $/€ mid-market exchange rate on the date of the report publication issued at 16:00 GMT/UTC by XE.com (www.XE.com). Mid-market rates are derived from mid-point between the buy and sell rates of large-value transactions in the global currency markets.

A key objective of the calculation procedure is to provide a weekly summary that is most strongly aligned to the reported market price positions on the date of publication.

Where ICIS price quotations are not available for individual weeks due to public holidays, then prior week data is carried forward for the specific purpose of populating the model and preventing model inconsistency. This form of data interpolation is inferring some limited data points that may not be market derived, and customers should be aware of this assumption.

All data in the ICIS Weekly Margin – EG Europe report is denominated in euros unless specifically indicated otherwise.

LONGER RANGE VIEWS

SPOT VERSUS CONTRACT MARGIN (INTEGRATED)

This provides a weekly comparison of the calculated margin for spot-based MEG sales minus contract-based sales. This switch of ICIS pricing reference is also considered for the naphtha cracker products, so the analysis is deeper than a simple comparison of spot-based MEG versus contract MEG price netbacks. When this differential provides a positive numerical output, this implies that spot-based MEG sales derive a higher margin for an integrated producer than contract-based sales. Similarly, when this differential provides a negative numerical output, this implies that spot-based MEG sales derive a lower margin for an integrated producer than contract based sales.

For the avoidance of any doubt, the basis in which ICIS pricing data is utilised for each of these respective models is summarised in the table below. For more detailed information about these quotations, please refer to the assessment Inputs section above.

ICIS price	Spot margin model	Contract margin model
MEG	Spot	Contract
DEG	Spot	Spot
Naphtha	Spot	Spot
Gasoline	Spot	Spot
Fuel Oil	Spot	Spot

Ethylene	Spot	Contract
Propylene	Spot	Contract
Butadiene	Spot	Contract
Benzene	Spot	Contract
Raffinate-1	Spot	Spot

SPOT VERSUS CONTRACT MARGIN (STANDALONE)

This provides a comparison of the calculated margin for spot-based MEG sales minus contract-based sales measured across the EO/MEG unit. When this differential provides a positive numerical output, this implies that spot-based MEG sales derive a higher margin than contract-based sales. Similarly, when this differential provides a negative numerical output, this implies that spot-based MEG sales derive a lower margin than contract-based sales.

The ICIS Weekly Margin – EG Europe report will provide a spot versus contract margin (integrated) and a spot versus contract margin (standalone) chart on alternate weeks.

The ICIS Weekly Margin – EG Europe report will also provide a longer range view of integrated MEG contract margins and integrated MEG spot margins on alternate weeks

READING THE CHARTS

In the short-term charts and longer range margin views, the integrated margin is derived by reading the top of the wedge, the sum of the ethylene margin per tonne of MEG (yellow) and the standalone MEG margin (blue). Where the standalone margin is a loss (red), the integrated margin is read as the top of the yellow wedge or, where there is no yellow wedge, the bottom of the red

PUBLISHING FREQUENCY

The ICIS Weekly Margin – EG Europe report is produced on a Monday using data from Friday close of business in Europe and distributed to customers on the Monday, subject to schedule planning. When the Monday is a public holiday in the UK, the report is distributed on the Tuesday. The report is not published on some public holidays. Holiday dates and days of publication may be subject to revision.

Find more information about ICIS' full portfolio of margin reports, visit http://www.icis.com/chemicals/channel-info-about/margin-reports/