

ETHYLENE GLYCOL ASIA

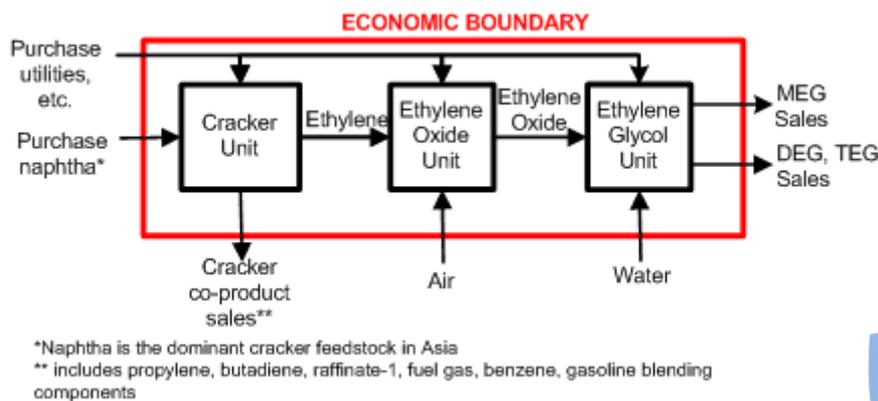
ICIS Weekly Margin – Ethylene Glycol (EG) Asia Methodology

This document is intended to provide methodology support for customers receiving the ICIS Weekly Margin – EG Asia 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:



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.
- 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).
- 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.
- 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 Asia. As such, the cost model is broadly applicable to the majority of the Asian 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.
- The ICIS spot MEG CFR China main port assessment is referenced as this is broadly representative of the Asian spot market.

Below is a detailed calculation of how the MEG margin is calculated for northeast Asia.

The figures refer to averages for 2010; the calculation for southeast Asia 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 price	887
Logistics costs	(22)
Net selling price	865
Purchase feedstock (naphtha) ¹	(1559)
Oxygen	(30)
Co-product sales/tonne of MEG produced ^{2,3}	1219
Variable cost of EO/MEG unit ⁴	<u>(171)</u>
	(541)
<i>Integrated margin</i>	324

Standalone margin	\$/tonne MEG
MEG price	887
Logistics costs	<u>(22)</u>
Net selling price	865
Ethylene price	(1113)
Freight/terminalling saving for not exporting	<u>105</u>
Net ethylene price paid	(1008)
Net ethylene price /tonne MEG produced ³ ie purchase feedstock (ethylene)	(650)
Purchase oxygen/tonne of MEG produced	(30)

Co-product value of DEG/TEG/tonne of MEG produced	122
Variable cost of EO/MEG unit ⁴	<u>(171)</u>
	(729)
<i>Standalone margin</i>	<i>136</i>

¹The 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 \$738/tonne.

²Co-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.

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

⁴Includes 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 Asia.
- 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 Asia.

WHY INTEGRATED ANALYSIS

- Integrated analysis provides the key reason for being (or 'raison d'être') in the commodity MEG business.

- Most Asian 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 Asia 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 Asia report.

NORTHEAST ASIA

- Mono ethylene glycol in Asia Pacific spot CFR China main port (ICIS pricing, weekly average) (\$/tonne)
- Diethylene glycol in Asia Pacific spot CFR China main port (ICIS pricing, weekly average) (\$/tonne)
- Naphtha in Asia Pacific spot CFR Japan (ICIS pricing, Friday assessment) (\$/tonne)
- Ethylene in Asia Pacific spot CFR NE Asia (ICIS pricing, weekly average) (\$/tonne)
- Propylene in Asia Pacific spot CFR NE Asia (ICIS pricing, weekly average) (\$/tonne)
- Propylene in Asia Pacific spot CFR China main port (ICIS pricing, weekly average) (\$/tonne)
- Butadiene in Asia Pacific spot CFR NE Asia (ICIS pricing, weekly average) (\$/tonne)
- Benzene in Asia Pacific spot CFR NE Asia (ICIS pricing, Friday assessment) (\$/tonne)
- Benzene in Asia Pacific spot FOB Korea (ICIS pricing, Friday assessment) (\$/tonne)
- Toluene in Asia Pacific spot CFR NE Asia (ICIS pricing, Friday assessment) (\$/tonne)
- Xylene (solvent grade) in Asia Pacific spot FOB Korea (ICIS pricing, Friday assessment) (\$/tonne)

- High sulphur fuel oil mixed/cracked 180 cst FOB Singapore spot (C1 Energy, weekly average) [from 29 August 2011, previously Fuel oil 180 cst Singapore spot (Reuters, weekly average)] (\$/tonne)

SOUTHEAST ASIA

- Mono ethylene glycol in Asia Pacific Spot CFR China main port (ICIS pricing, weekly average) (\$/tonne)
- Diethylene glycol in Asia Pacific Spot CFR China main port (ICIS pricing, weekly average) (\$/tonne)
- Naphtha in Asia Pacific Spot FOB Singapore (ICIS pricing, Friday assessment) (\$/bbl)
- Ethylene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly average) (\$/tonne)
- Propylene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly average) (\$/tonne)
- Butadiene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly average) (\$/tonne)
- Benzene in Asia Pacific Spot FOB SE Asia (ICIS pricing, Friday assessment) (\$/tonne)
- Toluene in Asia Pacific Spot CFR SE Asia (ICIS pricing, Friday assessment) (\$/tonne)
- Gasoline 95 unleaded FOB Singapore spot (C1 Energy, weekly average) [from 29 August 2011, previously Gasoline 95 unleaded FOB Singapore cargo spot (Reuters, weekly average)] (\$/bbl)
- High sulphur fuel oil mixed/cracked 180 cst FOB Singapore spot (C1 Energy, weekly average) [from 29 August 2011, previously Fuel oil 180 cst Singapore spot (Reuters, weekly average)] (\$/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 of www.icispricing.com

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 Asia report is denominated in US dollars unless specifically indicated otherwise.

LONGER RANGE VIEWS

The ICIS Weekly Margin – EG Asia report will provide longer range views for NE Asia and SE Asia margins on alternate weeks.

SOUTHEAST ASIAN MARGIN VERSUS NORTHEAST ASIAN MARGIN (INTEGRATED)

This provides a weekly comparison of the calculated integrated styrene spot margin for southeast Asian operators minus the calculated integrated styrene spot margin for northeast Asian operators. When this differential provides a positive numerical output, this implies that integrated styrene spot margins are higher for southeast Asian operators than for northeast Asian operators.



Similarly, when this differential provides a negative numerical output, this implies that integrated styrene spot margins are higher for northeast Asian operators than for southeast Asian operators.

READING THE CHARTS

In the short-term charts and longer range margin view, 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.

PUBLISHING FREQUENCY

The ICIS Weekly Margin – EG Asia report is produced on a Friday at the close of business in Asia and distributed to customers the following 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/>