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Ethylene Glycol Europe Variable Margin Analytics Methodology

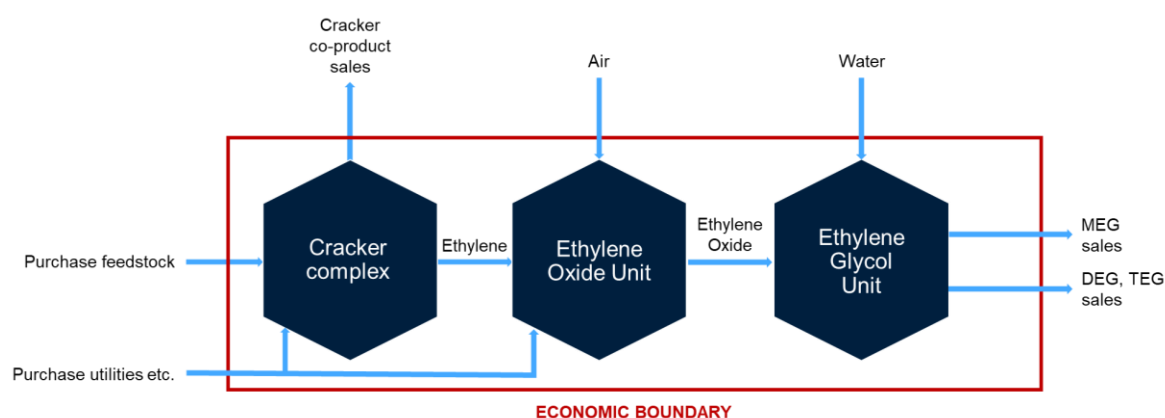


THE BUSINESS MODEL

The simplified diagram below shows the main method of making ethylene glycol (EG) from starting from a steam-cracker.

Naphtha (or LPG, or ethane) 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 EG and higher molecular weight glycols including diethylene glycol (DEG) and triethylene glycol (TEG). The cracker co-products are also separated, and either sold for use in other chemical plants or used as fuel.

A simplified illustration of material flows is as follows:



THE MARGIN CALCULATION

- The margin measure provides an assessment of the ex-works cash margin obtained for the product over raw material costs, credit for selling co-products and key variable manufacturing costs, including power and steam, chemicals and catalysts. This measure can also be termed as a variable margin, contribution or benefit.
- This margin measure provides simple signals on the direction of business margins as dictated by the environment, thus informing market positioning by sellers, buyers and traders.
- ICIS does not model beyond raw material costs, credit for selling co-products and key variable manufacturing costs. Further analysis would cease to be generic to the industry and would be 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.

- ICIS models plant operations for a series of 'representative' plants around the world. These representative plants have no flexibility with respect to feedstock or process configuration and ICIS assumes the plants to be purchasing inputs and selling outputs at constant prices.
- As the process model is generic and not based on any individual operation, the contribution measure is indicative. Instead of absolute value terms, it is most valuable as an index and in step-change terms.
- ICIS plant manufacturing and feedstock yield assumptions incorporate data from Intratec (www.intratec.us), an independent provider of chemical production cost reports.
- Ex-works product price assessments link to ICIS pricing quotations for large-volume commodity products, with netbacks assessed using the ICIS petrochemicals logistics model. To estimate representative transport costs, the ICIS logistics model considers a network with nodes at individual production sites connected by streets and ports linking each continent. The logistics model incorporates shipping data from Xeneta (www.xeneta.com), and duties data from SimplyDuty (www.simplyduty.com).

The calculation below shows how ICIS derives the ethylene glycol margin (feedstock naphtha) for North West Europe. The example is based on contract sales prices, is denominated in US dollars per tonne, and uses average prices for the year 2017.

Naphtha-based cracker margin (\$/tonne)

EG contract price	1,049
Logistics costs/netbacks	(168)
EG product value	881
Co-product sales	711
Total income	1,592
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Purchase feedstock (naphtha)	809
Utilities	92
Variable costs	901
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Ethylene glycol margin	1,592 – 901 = 691



MODEL YIELD PATTERN AND CALCULATION

Plant manufacturing data relates to the variable cost components of the cracker operations. Yield pattern data relates to the overall material balance of the cracker unit. For example, for 1 tonne of ethylene glycol produced, a cracker will use approximately 1.5 tonnes of naphtha as feedstock. In addition to the 1 tonne of ethylene glycol, the cracker will produce around 3 tonnes of co-products (including diethylene glycol, triethylene glycol, propylene, butadiene, benzene, raffinate-1, pygas and a fuel export balance).

- Naphtha is the dominant cracker feedstock in Europe. ICIS also models LPG feedstocks (propane and butane) as some cracker units are flexible, and able to increase LPG usage when economically favourable.
- European ethylene glycol margins are calculated for three different production processes in North West and Mediterranean Europe:
 - Naphtha Ethylene Glycol Generic
 - LPG Ethylene Glycol Generic
 - Standalone Ethylene Glycol Generic
- Due to the different cracker yield patterns when using naphtha or LPG feedstocks, a comparative analysis is not a simple case of comparing feedstock price differences, but must take into account the different co-product credits.
- This analysis demonstrates business volatility and the influence of price floors (as an uneconomic margin generally forces supply reductions).

ASSESSMENT INPUTS

The following ICIS inputs are used to generate the full content of the ICIS Ethylene Glycol Europe margins:

- Ethylene Glycol in Europe Spot FCA NWE (weekly average) (converted from €/tonne to \$/tonne)
- Ethylene Glycol in Europe Contract FD NWE (monthly assessment) (converted from €/tonne to \$/tonne)
- Diethylene Glycol in Europe Spot FD NWE (weekly average) (converted from €/tonne to \$/tonne)
- Naphtha in Europe Spot CIF NWE (weekly average) (\$/tonne)
- Naphtha in the Mediterranean Spot FOB (\$/tonne)



- Butane in Europe Spot CIF NWE 3000mt+ (Friday assessment) (converted from €/tonne to \$/tonne)
- Butane Bethioua Contract FOB (monthly assessment) (\$/tonne)
- Propane in Europe Spot CIF NWE 3000mt+ (Friday assessment) (converted from €/tonne to \$/tonne)
- Propane Bethioua Contract FOB (monthly assessment) (\$/tonne)
- Gasoline: Unleaded Premium in Europe Spot FOB Barges NWE (weekly average) (\$/tonne)
- Fuel Oil 3.5% in Europe Spot CIF Cargoes NWE (weekly average) (\$/tonne)
- Natural Gas, TTF Price Assessment, October '22, Bid/Offer Range, Daily, DEL TTF (€/MWh, converted to \$/MmBTU)
- Ethylene in Europe Monthly Contract FD NWE (converted from €/tonne to \$/tonne)
- Ethylene in Europe Spot, Assessment, Pipeline, 0-6 Weeks, Full Market Range, Weekly, FD NWE (€/tonne)
- Ethylene in the Mediterranean Spot CIF (\$/tonne)
- Propylene in Europe Monthly Contract FD NWE (converted from €/tonne to \$/tonne)
- Propylene (Polymer Grade) in Europe Spot CIF NWE (converted from €/tonne to \$/tonne)
- Butadiene in Europe Monthly Contract FD NWE (converted from €/tonne to \$/tonne)
- Butadiene in Europe Spot FD NWE (\$/tonne)
- Benzene in Europe Monthly Contract FOB NWE (converted from €/tonne to \$/tonne)
- Benzene in Europe Spot CIF ARA (\$/tonne)
- Raffinate-1 in Europe Spot CIF NWE (\$/tonne)

The methodology associated with each individual ICIS pricing quotation referenced above is available on the ICIS Compliance and Methodology website.

In addition to the listed ICIS pricing inputs, the model also takes into account logistics costs (calculated through the ICIS logistics model), and utility costs.

Where price inputs are unavailable for Mediterranean Europe, costs are calculated by applying logistics costs to prices in North West Europe.

A key objective of the calculation process is to provide a weekly summary that strongly aligns to the reported market price positions on the date of release.



Where inputs are unavailable for individual weeks, e.g. due to public holidays, prior-week data is carried forward to the current week. This is for the specific purpose of populating the model and preventing model inconsistency. This form of data interpolation infers some limited data points that may not be market derived, and customers should be aware of this assumption.

As the majority of petrochemical trades are in US dollars, all data used in the ICIS Margin – Ethylene Glycol Europe model are denominated in USD unless specifically stated otherwise. Where the original assessed price is in euros, ICIS uses the USD/EUR mid-market exchange rate issued at 16:00 UTC (GMT) on the date of the ICIS price report publication by XE (www.xe.com). When converting contract prices, the mid-market exchange rate quoted on first day of the given month is used. In the case that the first day of any month falls on a weekend, the mid-market exchange rate of the previous Friday is used.

The basis on which ICIS pricing data is used for the calculation of spot and contract prices is summarised in the table below.

ICIS Price	North West Europe		Mediterranean Europe
	Spot margin	Contract margin	Spot margin
EG	Spot	Contract	Spot
DEG	Spot	Spot	Spot
Naphtha	Spot	Spot	Spot
Butane	Spot	Spot	Contract
Propane	Spot	Spot	Contract
Gasoline	Spot	Spot	Spot
Fuel Oil	Spot	Spot	Spot
Ethylene	Spot	Contract	Spot
Propylene	Spot	Contract	Spot
Butadiene	Spot	Contract	Spot
Benzene	Spot	Contract	Spot
Raffinate-1	Spot	Spot	Spot

ETHYLENE GLYCOL EUROPE WEBPAGE

Filter data on the website using the following criteria.

- **Area:** Select from Mediterranean Europe and North West Europe.



- **Process:** Select from Naphtha Ethylene Glycol Generic, LPG Ethylene Glycol Generic, and Standalone Ethylene Glycol Generic.
- **Price terms:** ICIS generates variable margins for both contract and spot price terms.

Variable margins data are available online from January 2014 onwards. One year of trailing data shows as default.

The website deploys the following data, all per tonne of ethylene glycol.

- **Main product value, ex-works:** the estimated ethylene glycol netback value for the producer, taking into account the ICIS assessed price, shipping costs, handling costs and applicable duties.
- **Co-product credits:** the revenues from the other products generated in a process, also ex-works. This data is also available broken down into co-product types.
- **Feedstock and utility costs:** or total variable input costs for a process. This data is also available broken down into the component feedstock costs and utility costs.

Calculated outputs are:

- **Variable cost** = [Feedstock and utility costs] – [Co-product credits]
- **Variable margin** = [Main product value] + [Co-product credits] – [Feedstock and utility costs]

A selected variable margin (i.e. a margin for a specific location, process and price term) is comparable with margins of different process technologies in the same region, and with margins using the same technology in different regions. Subscribers can review margin performance by week, month, quarterly and per annum. Subscribers can view the flows of different products, in terms of their volume and value, into and out of the representative production unit used to calculate the ethylene glycol variable margin.

PUBLICATION FREQUENCY

The ICIS Weekly Margin – Ethylene Glycol Europe model is based on the latest data at the close of business in Europe on Friday and released to customers on the following Monday, along with written commentaries, subject to schedule planning. When the Monday is a public holiday in the UK, commentaries will be made available



the following day. ICIS does not publish the report on some public holidays. Holiday dates and days of publication may be subject to revision.

The margins feature allows users to select data for the period they are most interested in from January 2014 onwards. Key margins data includes the calculated margins, feedstock and utility costs and the assessed ex-works values for co-product credits and ethylene glycol on a weekly basis. Combined with relevant price history series, also available via ICIS dashboard, this allows subscribers to manipulate ICIS data more easily than was previously possible.