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Variable Margin Methodology: Ethylene Europe

ICIS
Independent Commodity Intelligence Services

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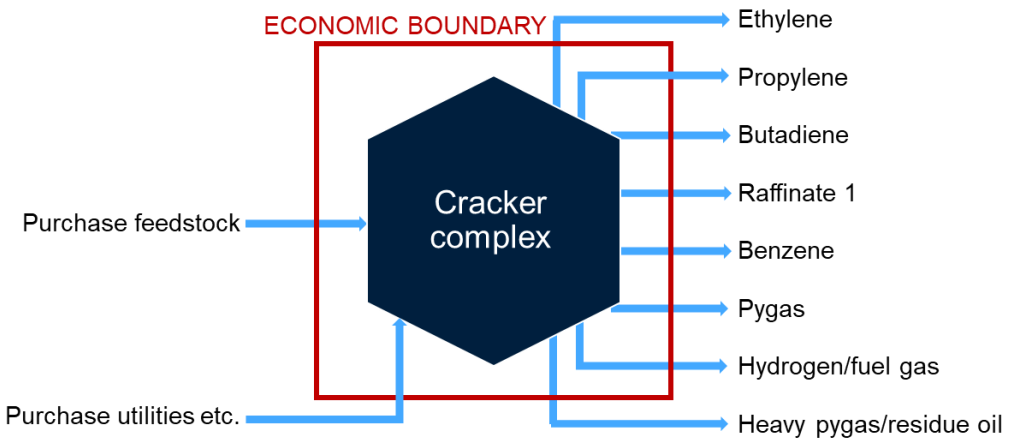
THE BUSINESS MODEL

The diagram below shows a simplified ethylene production process using naphtha and/or liquefied petroleum gas (LPG) as feedstocks. Naphtha is a product mainly derived from crude oil, while LPG and ethane are derived from gas separation processes and as a by-product of refinery processes or natural gas extraction.



In the most common ethylene production process, naphtha and steam are fed into a cracker unit, where ethylene and its co-products (such as propylene, butadiene and benzene) are made. Ethylene is separated from co-products and typically piped to other chemical plants where it is further processed into derivative products such as polyethylene. Its co-products are also separated, and either sold for use in other chemical plants, or used as fuel.

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. In North West Europe, this representative plant is situated in Antwerp, while for Mediterranean Europe, this plant is located in Tarragona.

- 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 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)

Ethylene contract price		1,146
Logistics costs/netbacks		(92)
Ethylene product value		**1,054**
Co-product sales		**1,072**
Total income		**2,126**
Purchase feedstock (naphtha)		1,418
Utilities		50
Variable costs		**1,468**
Ethylene margin	2,126 – 1,468	**= 658**

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 one tonne of ethylene produced, a cracker will use approximately three tonnes of naphtha as feedstock. In addition to the ethylene, the cracker will produce co-products (including propylene, butadiene, benzene, raffinate-1, pygas, fuel oil and fuel gas).

- Naphtha is the dominant cracker feedstock in Europe. ICIS also models LPG feedstocks (propane and butane) and ethane as some cracker units are flexible, and able to increase usage of different feedstocks when economically favourable.

- European ethylene margins are calculated for the following production processes in North West and Mediterranean Europe:
    - LPG steam cracking with benzene and butadiene extracted
    - Naphtha 80/LPG 20 with benzene and butadiene extracted
    - Naphtha steam cracking with benzene and butadiene extracted

  The following ethylene margins are only modelled in North West Europe:
    - Ethane Steam Cracking

- Due to the different cracker yield patterns when using ethane, 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

ICIS uses the following inputs to generate the full content of the ICIS Ethylene Europe margins:

- 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**)**

Ethane values are derived from a US gas price

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 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**
Naphtha	Spot	Spot	Spot
Butane	Spot	Spot	Contract
Propane	Spot	Spot	Contract
Ethane	Spot	Spot	N/A
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 EUROPE WEBPAGE

Filter data on the website using the following criteria.

- **Area:** Select from Mediterranean Europe and North West Europe.
- **Process**: Select from LPG steam cracking, naphtha 80/LPG 20 steam cracking, naphtha steam cracking and ethane steam cracking.
- **Price terms**: ICIS generates variable margins for both contract and spot price terms.

Variable margins data are available online from January 2014 onwards. Six months trailing data shows as default.

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

- **Main product value, ex-works**: the estimated ethylene 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 variable margin.

PUBLICATION FREQUENCY

The ICIS Weekly Margin – Ethylene 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 margin updates on some public holidays. Holiday dates and days of publication may be subject to revision.