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Variable Margin Methodology: Polyethylene Europe

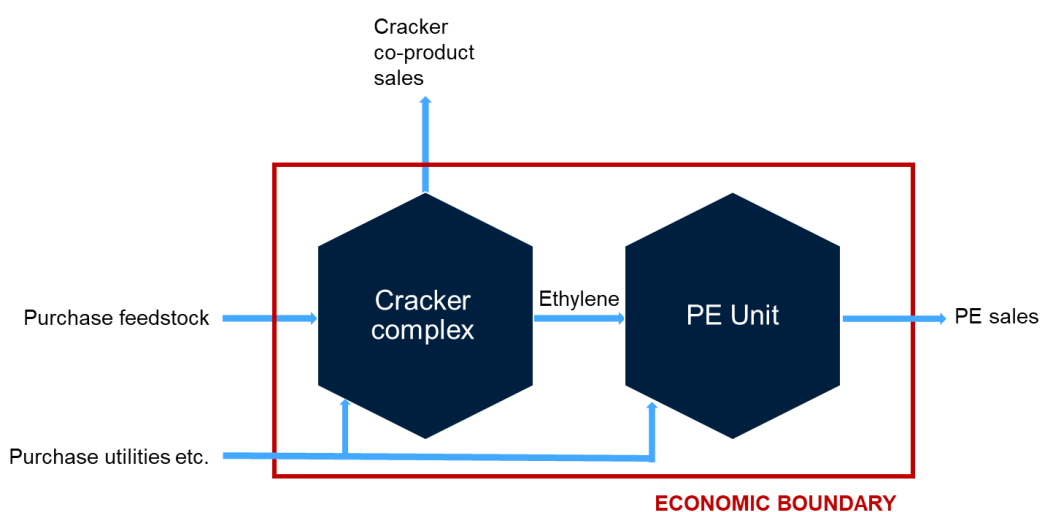


THE BUSINESS MODEL

Polyethylene (PE) is produced via the polymerisation of ethylene. The main feedstocks for polyethylene in Europe are naphtha and liquefied petroleum gas (LPG).

Naphtha is a product mainly derived from crude oil. Naphtha and steam are fed into a cracker unit where ethylene and other co-products (such as propylene, butadiene and benzene) are made. Ethylene is separated from co-products and piped to a PE plant, where it is further processed (polymerised) to make PE pellets for sale. Co-products are separated and sold for use in other chemical plants, or used for fuel.

LPG can be derived from gas separation processes and as a by-product of refinery processes. It is cracked with steam, in a similar way to naphtha, but the co-product slate is different and generally lighter than naphtha, with ethylene and propylene produced along with smaller amounts of co-products.



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.
- For naphtha-based polyethylene margin calculations in Russia, polypropylene values have been used to calculate propylene co-product contributions.
- 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).
- ICIS calculates margins for low-density polyethylene (LDPE), high-density polyethylene resin (HDPE), and linear low-density polyethylene (LLDPE) in the polyethylene variable margins model.

The calculation below shows how ICIS derives the LDPE 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 integrated margin (\$/tonne)

LDPE contract price	1,673
Logistic costs/netbacks	(133)
LDPE product value	1,540
Co-product sales	1,102
<u>Total income</u>	<u>2,642</u>



Total chemical input costs	1,442
Utilities	115
<u>Variable costs</u>	<u>1,557</u>
<u>LDPE margin</u>	<u>2,642 – 1,557 = 1,085</u>

Standalone margin (\$/tonne)

LDPE contract price	1,673
Logistic costs/netbacks	(133)
LDPE product value	1,540
Co-product sales	23
<u>Total income</u>	<u>1,563</u>
Total chemical input costs	1,077
Utilities	65
<u>Variable costs</u>	<u>1,142</u>
<u>LDPE margin</u>	<u>1,563 – 1,142 = 421</u>

- Note: This calculation assumes the use of 1.01 tonnes of ethylene to produce one tonne of LDPE.

INTEGRATED AND STANDALONE

- Non-integrated or standalone market participants produce PE only. Our margin model assumes plants that are co-located and that the ethylene is transferred as part of the process.
- Standalone analysis, which considers the polymer unit in isolation, helps to identify marginal opportunities, e.g. where ethylene could be more profitably used for other ethylene derivative products. No standalone analysis is performed for Russian margins.
- Integrated market participants produce both ethylene and PE. The business model is to buy naphtha and/or LPG feedstock, process it into ethylene and cracker co-products, convert the ethylene into PE, and sell both the PE and cracker co-products. This business model is applicable to the majority of manufacturing facilities in Europe.
- Most North West European PE plants are integrated with cracker sources of ethylene (approximately 90% by capacity). These may be co-located and/or connected by pipeline and with common equity ownership across both assets in the supply chain. Therefore, the economic boundary for the majority of industry producers is more extensive than a standalone polymer unit.



- The margin is measured across the supply chain from cracker feedstock through to PE and cracker co-products.
- Analysis of integrated plants demonstrates business volatility and the influence of price floors, which can lead to an uneconomic integrated margin, and generally force a reduction in supply.

MODEL YIELD PATTERN AND CALCULATION

Plant manufacturing data relates to the variable cost components of cracker operations. Yield pattern data relates to the overall material balance of the cracker unit. For example, for 1 tonne of ethylene produced, a cracker will use approximately three tonnes of naphtha as feedstock. In addition to the one tonne of ethylene, the cracker will produce (including propylene, butadiene, benzene, raffinate-1, pygas, fuel oil and fuel gas). These calculations also take into consideration additional chemicals and catalysts required for the synthesis of PE.

Intratec provides the plant manufacturing and feedstock yield data used in the model.

- 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.
- ICIS calculates polyethylene margins for HDPE, LLDPE and LDPE grades. Margins are calculated for the following production processes:

NORTH WEST EUROPE AND MEDITERRANEAN EUROPE

- HDPE:
 - LPG HDPE Solution
 - Naphtha HDPE Solution
 - Standalone HDPE Solution
- LLDPE:
 - LPG LLDPE Solution
 - Naphtha LLDPE Solution
 - Standalone LLDPE Solution
- LDPE:
 - LPG LDPE High Pressure Tubular
 - Naphtha LDPE High Pressure Tubular
 - Standalone LDPE High Pressure Tubular



RUSSIA

- Naphtha HDPE Solution
 - Naphtha LLDPE Solution
 - Naphtha LDPE High Pressure Tubular
- Due to the different cracker yield patterns when using different feedstocks, a comparative analysis is not a simple case of comparing feedstock price differences, but must take into account co-product credits.
- This analysis demonstrates the volatility of the business 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 Polyethylene Europe margins:

NORTH WEST AND MEDITERRANEAN EUROPE

- Polyethylene LDPE (GP Film) in Europe domestic FD EU (converted from €/tonne to \$/tonne)
- Polyethylene LDPE (GP Film) in Europe spot FD NWE (converted from €/tonne to \$/tonne)
- Polyethylene HDPE (Injection) in Europe domestic FD (converted from €/tonne to \$/tonne)
- Polyethylene HDPE (Injection) in Europe spot FD NWE (converted from €/tonne to \$/tonne)
- Polyethylene LLDPE Butene C4 in Europe spot FD NWE (converted from €/tonne to \$/tonne)
- Polyethylene LLDPE Butene C4 in Europe domestic FD EU (converted from €/tonne to \$/tonne)
- Naphtha in Europe spot CIF NWE (Friday assessment) (\$/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 ARA (\$/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 FOB Rotterdam (\$/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)

RUSSIA

- HDPE Injection, Ex-works, Assessment, 0-4 Weeks, Full Market Range, Weekly
- LDPE GP Film, Ex-works, Assessment, 0-4 Weeks, Full Market Range, Weekly
- Homopolymer Raffia, Ex-Works, Assessment, 2-4 Weeks, Full Market Range, Weekly

Where appropriate, ICIS adjusts reported contract prices to better reflect actual market conditions. In some cases this means applying a reduction to reported contract price levels for use in our calculations.

The methodology associated with each ICIS pricing individual 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 logistic costs (calculated through the ICIS logistics model), and utilities costs.

Where price inputs are unavailable for Mediterranean Europe or Russia, ICIS calculates costs by applying logistics fees to prices given 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 made in US dollars, all data used in the ICIS Margin – Polyethylene 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. For detailed information about these quotations, please refer to the Assessment Inputs section above.

ICIS price	North West Europe		Mediterranean Europe
	Spot margin	Contract margin	Spot margin
LDPE	Spot	Domestic	Domestic
HDPE	Spot	Domestic	Domestic
LLDPE	Spot	Domestic	Domestic
Naphtha	Spot	Spot	Spot
Gasoline	Spot	Spot	Spot
Butane	Spot	Spot	Contract
Propane	Spot	Spot	Contract
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

POLYETHYLENE EUROPE WEBPAGE

Filter data on the website using the following criteria.

- **Area:** Select from Mediterranean Europe, North West Europe and Russia
- **Process:** Process type can be selected for each PE grade:
 - **HDPE:** LPG HDPE solution, naphtha HDPE solution, standalone HDPE solution.



- **LDPE:** LPG LDPE high pressure tubular, naphtha LDPE high pressure tubular, standalone LDPE high pressure tubular.
- **LLDPE:** LPG LLDPE solution, naphtha LLDPE solution, standalone LLDPE solution.
- **Price terms:** ICIS generates variable margins for both contract and spot price terms.

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

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

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

PUBLICATION FREQUENCY

The ICIS Weekly Margin – Polyethylene 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 an update on some public holidays. Holiday dates and days of publication may be subject to revision.