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Variable Margin Methodology: Light Olefins Europe

ICIS
Independent Commodity Intelligence Services

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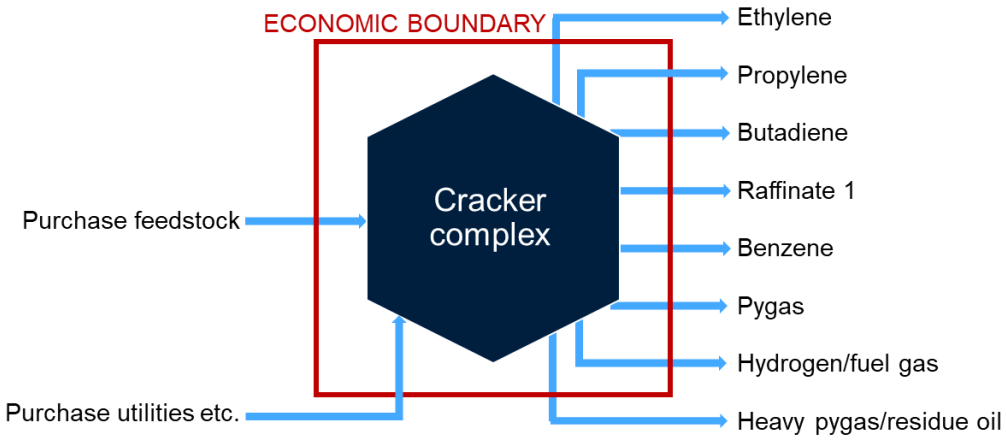
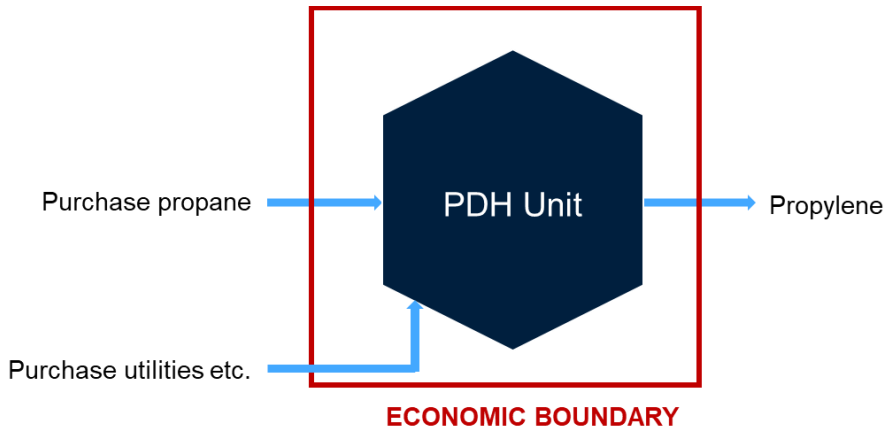
THE BUSINESS MODEL

For Europe, light olefins (2:1 ethylene-to-propylene ratio) margins are calculated for naphtha, liquefied petroleum gas (LPG), and propane feedstocks. The diagram below shows a simplified light olefins production process using naphtha and/or liquefied petroleum gas (LPG) as feedstocks. Naphtha is a product mainly derived from crude oil, while LPG derives from gas separation processes and as a by-product of refinery processes.



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

Propane dehydrogenation (PDH) is a common method for producing propylene. Propane is fed into a PDH unit over a catalyst to produce propylene, which is then sold, or further processed to make polypropylene.



THE MARGIN CALCULATION

- The margin measure provides an assessment of the ex-works cash margin obtained for the products 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).

- ICIS calculates light olefins margins rather than pure propylene margins as most market participants produce both ethylene and propylene through steam cracking. This margin model also gives measure of the profitability of the propane dehydrogenation process. From this, comparisons can be drawn between margins for ethylene and propylene, and their derivative products, polyethylene and polypropylene.

The calculation below shows how ICIS derives the light olefins margin (feedstock naphtha) for 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)

Light olefins* weighted contract price	1,079
Logistics costs/netbacks	(72)
Light olefins product value	**1,007**
Co-product sales	**399**
Total income	**1,406**
Purchase feedstock (naphtha)	945
Utilities	33
Variable costs	**978**
Light olefins margin	1,406 – 978 = **428**

*2:1 ethylene-to-propylene ratio

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, a cracker will use approximately two tonnes of naphtha as feedstock to produce one tonne of light olefins. In addition to the one tonne of light olefins, the cracker will produce approximately one tonne of co-products (including 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) as some cracker units are flexible, and able to increase LPG usage when economically favourable.

- European light olefins margins are calculated for the following production processes in North West and Mediterranean Europe:
    - Propane dehydrogenation
    - 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

- 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 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 Light Olefins 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)

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, 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 in US dollars, all data used in the ICIS Margin – Light Olefins 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**
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

LIGHT OLEFINS EUROPE WEBPAGE

Filter data on the website using the following criteria.

- **Area:** Select from Mediterranean Europe and North West Europe
- **Process**: Select from Propane dehydrogenation, LPG steam cracking, naphtha 80/LPG 20 steam cracking, and naphtha 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 light olefins.

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

PUBLICATION FREQUENCY

The ICIS Weekly Margin – Light Olefins 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.