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Variable Margin Methodology: Polypropylene Americas

ICIS
Independent Commodity Intelligence Services

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THE BUSINESS MODEL

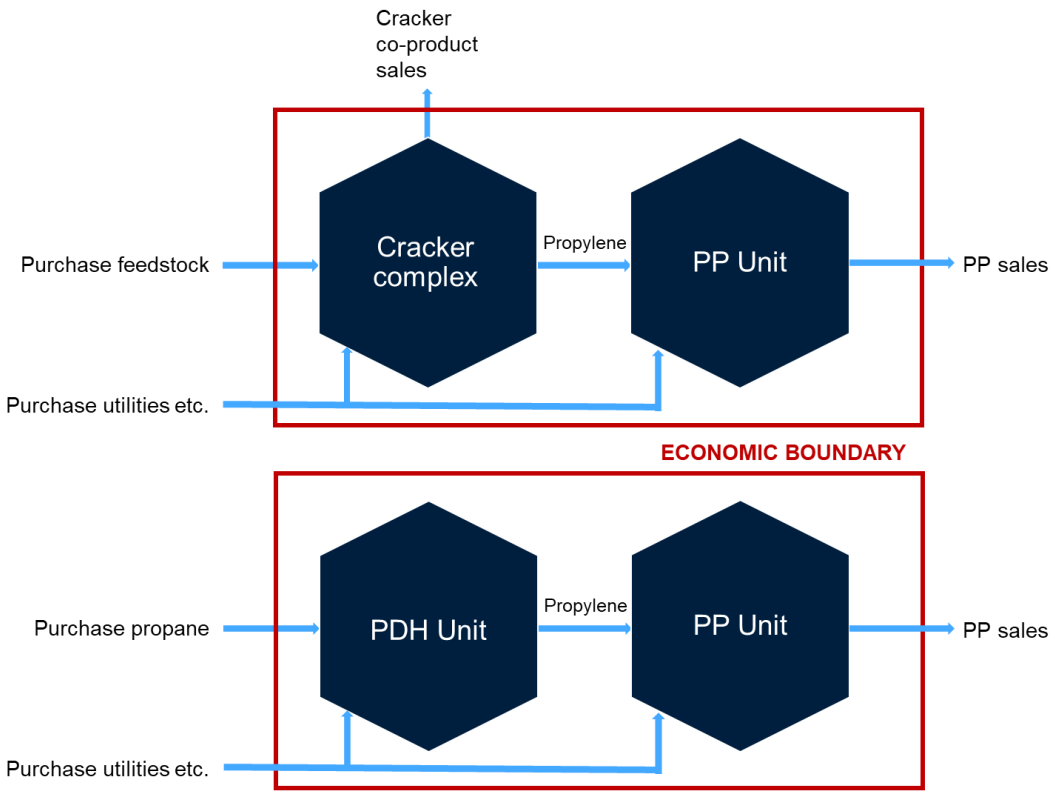
Polypropylene (PP) margins in the US are calculated for naphtha, liquefied petroleum gas (LPG), and propane feedstocks.

Naphtha is a product mainly derived from crude oil, while LPG derives from gas separation processes and as a by-product of refinery processes. Propane is a gaseous feedstock derived via separation from natural gas, and from petroleum refining.

The first method of PP manufacture is to produce propylene through steam cracking either naphtha or LPG, then using the propylene in a PP plant to produce PP for sale.

The second method of producing PP is the propane dehydrogenation (PDH) process. Propane is fed into a PDH unit over a catalyst to produce propylene. This propylene is then further processed to make PP.

The diagram below show the process of making polypropylene from naphtha or LPG, and from propane feedstock.



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.

- 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 PP grade referenced in the ICIS Polypropylene US Margin report is PP homopolymer injection moulding grade.

The calculation below demonstrates how ICIS derives the PP margin for the US. The examples given are based on contract sales prices, denominated in US dollars per tonne, and use average prices for the year 2017.

Naphtha-based integrated margin ($/tonne)

Polypropylene contract price		1,434
Logistic costs/netbacks		(55)
Polypropylene product value		**1,379**
Co-product sales		**407**
Total income		**1,786**
Total chemical input costs		913
Utilities		56
Variable costs		**969**
Polypropylene margin	1,786 – 969	**= 817**

Standalone margin ($/tonne)

Polypropylene contract price		1,434
Logistics costs/netbacks		(55)
Polypropylene product value		**1,379**
Total chemical input costs		936
Utilities		27
Variable costs		**963**
Polypropylene margin	1,379 - 963	**= 416**

PDH integrated margin ($/tonne)

Polypropylene contract price		1,434
Logistics costs/netbacks		(55)
Polypropylene product value		**1,379**
Co-product sales		**2**
Total income		**1,381**
Total chemical input costs		497
Utilities		99
Variable costs		**596**
Polypropylene margin	1,381 - 596	**= 785**

INTEGRATED AND STANDALONE

- Non-integrated or standalone market participants produce polypropylene only. Our margin model assumes plants that are co-located and the propylene is sourced from the open market. Standalone processes are not modelled for Brazil.

- Integrated market participants produce propylene and polypropylene (as well as ethylene for a fully integrated supply chain). In a fully integrated supply chain, the business model is to buy naphtha, process it into propylene, benzene, butadiene and other cracker co-products. The propylene is then converted into polypropylene.

- Integrated production units 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.

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 propylene produced, a cracker will use approximately 3 tonnes of naphtha as feedstock. In addition to the 1 tonne of propylene, the cracker will produce around 1.5 tonnes of co-products (including butadiene, benzene, raffinate-1, pygas fuel oil, and fuel gas). A PDH unit will use approximately 1.2 tonnes of propane per tonne of propylene. These calculations also take into consideration power, and additional chemicals and catalysts required for the synthesis of PP.

- For the US Gulf, ICIS models propane, naphtha, and LPG feedstocks (propane and butane) as some cracker units are flexible, and able to increase LPG usage when economically favourable.
- For Brazil, ICIS models naphtha processes only.
- US Gulf polypropylene margins are calculated for four different production processes in the US:
    - LPG Polypropylene
    - Naphtha Polypropylene Bulk
    - Propane Polypropylene Bulk
    - Standalone Polypropylene Bulk
- Brazilian polypropylene margins are calculated for the following production process in the Brazil:
    - Naphtha Polypropylene Bulk
- Due to the different cracker yield patterns when using naphtha, propane, 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 Polypropylene Americas margins:

US GULF

- Polypropylene Homopolymer Injection DEL US Contract (cts/lb converted to $/tonne)
- Polypropylene Homopolymer Injection Bagged FOB USG (cts/lb converted to $/tonne)
- Ethane Mt Belvieu FOB USG Spot (weekly average) (cts/US gal converted to $/tonne)
- Naphtha in US Gulf Spot Del USG Paraffinic (weekly average) ($/tonne)
- Ethylene – Net US Gulf Contract Delivered (cts/lb converted to $/tonne)
- Ethylene in US Gulf Spot Del (Pipeline) (weekly average) (cts/lb converted to $/tonne)
- N-Butane, Assessment, In Store, 10-30 Days, Closing Value, Weekly, Mt Belvieu FOB USG Spot (cts/US gal converted to $/tonne)
- Propane Mt Belvieu FOB USG Spot (cts/US gal converted to $/tonne)
- Propylene in US Gulf Contract P Grade (cts/lb converted to $/tonne)
- Propylene (P Grade) in US Gulf Spot Pipeline (weekly average) (cts/lb converted to $/tonne)
- Butadiene in US Gulf Contract FOB USG (cts/lb converted to $/tonne)
- Butadiene in US Gulf Spot CIF (weekly average) (cts/lb converted to $/tonne)
- Crude C4s in US Gulf Spot CIF (weekly average) ($/tonne)
- Benzene in US Gulf Contract FOB ($/US gal converted to $/tonne)
- Benzene in US Gulf Spot FOB Barges (Friday assessment) ($/US gal converted to $/tonne)
- Gasoline Premium Unleaded (Pipeline) in US Gulf Spot US Gulf (weekly average) (cts/US gal converted to $/tonne)
- Residual Fuel Oil: FOB US Gulf (barges) Spot No 6 1.0% (weekly average) (cts/bbl converted to $/tonne)
- NYMEX Henry Hub Natural Gas forward month (ICIS Energy, weekly average) ($/MMBtu converted to $/tonne)

BRAZIL

- Polypropylene (Homopolymer) Injection spot FOT Brazil, Assessment, International, Full Market Range, Weekly

CONVERSIONS

The following conversion factors are used:

- Ethane: 742.2 US gal per tonne
- Benzene: 299 US gal per tonne
- Gasoline: 358.8 US gal per tonne
- Residual Fuel Oil: 264 US gal per tonne (42 US gal/bbl)
- Natural Gas: 0.0173 tonnes of fuel oil equivalents per MMBtu

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 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.

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 – Polypropylene Americas model are denominated in USD unless specifically stated otherwise.

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	**Spot margin**	**Contract margin**
Polypropylene	Spot	Domestic
Ethane	Spot	Spot
Naphtha	Spot	Spot
Butane	Spot	Spot

Propane	Spot	Spot
Gasoline	Spot	Spot
Fuel Oil	Spot	Spot
Ethylene	Spot	Contract
Propylene	Spot	Contract
Butadiene	Spot	Contract
Benzene	Spot	Contract
Crude C4	Spot	Spot

POLYPROPYLENE US WEBPAGE

Filter data on the website using the following criteria.

- **Location:** Select from US gulf and Brazil.
- **Process type**: Select from LPG polypropylene, naphtha polypropylene bulk, propane polypropylene bulk, and standalone polypropylene bulk.
- **Price terms**: ICIS generates variable margins for both contract and spot price terms. Brazil only has spot margins available

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 polypropylene.

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

PUBLICATION FREQUENCY

The ICIS Weekly Margin – Polypropylene Americas model is based on the latest data at the close of business in US 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 updates on some public holidays. Holiday dates and days of publication may be subject to revision.