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Variable Margin Methodology: Polypropylene Asia

ICIS
Independent Commodity Intelligence Services

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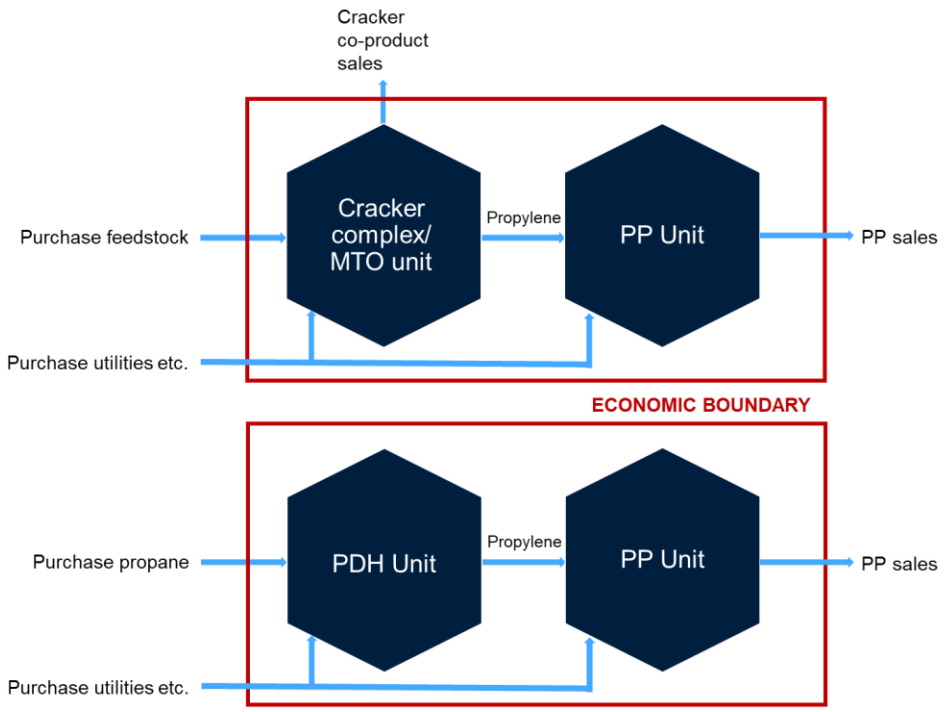
THE BUSINESS MODEL

The main feedstocks used in the production of polypropylene (PP) are naphtha, a product mainly derived from crude oil; propane from petroleum gas; liquefied petroleum gas (LPG) derived from gas separation processes and as a by-product of refinery processes; and methanol, produced from natural gas, and in this region, coal.

Naphtha and steam are fed into the cracker unit where ethylene, propylene and other co-products (such as butadiene and benzene) are made. Propane is fed into a propane dehydrogenation (PDH) unit over a catalyst, with propylene as the only product. Methanol is fed into a methanol to olefins (MTO) unit, producing propylene and ethylene. Propylene is then polymerised in the PP plant to make the PP pellets for sale.

ICIS also models polypropylene production integrated to the coal mouth.

ICIS also models the margin of PP imported from a Middle East producer. This unit is modelled as being in Saudi Arabia, and production has been modelled for both PDH and LPG-based processes. It includes freight costs and duties. If Middle East prices are not available, margin calculations will be based on another region, which will be specified in the event.



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 variable margin model for Asia is the PP flat yarn/raffia grade. This generally represents large-volume commodity grades in the PP market.

- ICIS spot China main port and spot SE Asia quotes are referenced as these are broadly representative of the northeast Asian and Southeast Asian markets respectively.

- MTO and PDH based processes value the transferred propylene on a purely propylene basis, as with these processes propylene is the major, or in the case of PDH the only, product.

- PP imported from the Middle East is modelled using a CFR GCC (gulf cooperation council) price plus freight and duties.

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

NORTHEAST ASIA

Naphtha-based cracker margin ($/tonne)

Polypropylene spot price	1,054
Logistics costs/netbacks	(3)
Polypropylene product value	**1,057**
Co-product sales	**381**
Total income	**1,438**
Purchase feedstock (naphtha)	1,050
Utilities	49
Variable costs	**1,099**

Polypropylene margin 1,438 – 1,099 = **339**

Standalone margin ($/tonne)

Polypropylene spot price	1,054
Logistics costs/netbacks	(3)
Polypropylene product value	**1,057**
Co-product sales	**-**
Total income	**1,057**
Purchase feedstock (propylene)	937
Utilities	25
Variable costs	**962**

Polypropylene margin 1,057 – 962 = **95**

PDH integrated margins ($/tonne)

Polypropylene spot price	1,054
Logistics costs/netbacks	(3)
Polypropylene product value	**1,057**
Co-product sales	**3**
Total income	**1,060**
Purchase feedstock (propane)	643
Utilities	163
Variable costs	**806**

Polypropylene margin 1060 – 806 = **254**

- The naphtha model assumes roughly 2 tonnes of naphtha are required to produce one tonne of light olefins (ethylene and propylene) and roughly a tonne of propylene are required to produce 1 tonne of PP.

- Co-product sales include credits for butadiene, benzene, raffinate-1, pygas fuel oil, and fuel gas. Since the cracker margin is based on 1 tonne of olefins (ethylene and propylene) produced, the figure also allows for the difference in net price between ethylene and propylene on transfer to the PP unit.

- The model assumes around 1 tonne of propylene are required to produce one tonne of PP.
    - Includes power and catalysts/chemicals for the PP.

- The model assumes roughly 5 tonnes of coal are required to make one tonne of PP.

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 production is not modelled for the Middle East.

- 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 one tonne of propylene produced, a cracker will use approximately two tonnes of naphtha as feedstock. In addition to the one tonne of propylene, the cracker will produce around 1.5 tonnes of co-products (including butadiene, benzene, raffinate-1, pygas and a fuel export balance). 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.

ASSESSMENT INPUTS

The following ICIS pricing inputs are used to generate the full content of the ICIS Weekly Margin – PP Asia report:

NORTHEAST ASIA

- Polypropylene (homopolymer) in northeast Asia spot CFR China main port; previously polypropylene (flatyarn) in Asia Pacific Spot CFR China Main Port [from 18 October 2002, previously Polypropylene (flatyarn) in Asia Pacific Spot CFR Hong Kong] ($/tonne)
- Naphtha in Asia Pacific Spot CFR Japan (ICIS pricing, Friday assessment) ($/tonne)
- Propane spot CFR Japan/Korea (refrigerated cargo) C1 Energy (Thursday assessment) [from 13 June 2014, previously weekly average from 1 November 2010, previously Propane C+F Tokyo Term Spot (Reuters, weekly average)] ($/tonne)
- Butane spot CFR Japan/Korea (refrigerated cargo) C1 Energy (Thursday assessment) [from 13 June 2014, previously weekly average from 1 November 2010; previously Butane Tokyo C+F Tokyo Term Spot (Reuters, weekly average)] ($/tonne).
- Butane spot CFR China (refrigerated cargo) (ICIS pricing, weekly average) ($/tonne)
- Methanol in China spot CFR, Assessment, Specific Origins, 2-9 Weeks, Full Market Range, Weekly, CFR China ($/tonne)
- Ethylene in Asia Pacific Spot CFR NE Asia (ICIS pricing, weekly average) ($/tonne)
- Propylene in Asia Pacific Spot CFR NE Asia (ICIS pricing, weekly average) ($/tonne)
- Propylene in Asia Pacific Spot CFR China Main Port (ICIS pricing, weekly average) ($/tonne)

- Butadiene in Asia Pacific Spot CFR NE Asia (ICIS pricing, weekly average) ($/tonne)
- Benzene in Asia Pacific Spot CFR NE Asia (ICIS pricing, Friday assessment) ($/tonne)
- Benzene in Asia Pacific Spot FOB Korea (ICIS pricing, Friday assessment) ($/tonne)
- Benzene in Asia Pacific Spot CFR Main China Ports (ICIS pricing, Friday assessment) ($/tonne)
- Toluene in Asia Pacific Spot CFR NE Asia (ICIS pricing, Friday assessment) ($/tonne)
- Xylene (Solvent Grade) in Asia Pacific Spot FOB Korea (ICIS pricing, Friday assessment) ($/tonne)
- Xylene (Solvent Grade) in Asia Pacific Spot CFR China ($/tonne)
- Fuel Oil 3.5% in Europe Spot CIF Cargoes NWE (weekly average) [from 5 January 2018, previously High Sulphur Fuel Oil mixed/cracked 180 cst FOB Singapore spot (C1 Energy, weekly average) [from 29 August 2011 to 29 December 2017], previously Fuel Oil 180 cst Singapore spot (Reuters, weekly average)] ($/tonne)

INLAND CHINA

- Coal in China Spot Ex-Works, thermal coal, (Weekly, CNY/tonne)
- Polypropylene in China Spot Ex-Warehouse China N (Weekly, Injection, CNY/tonne)

SOUTHEAST ASIA

- Polypropylene (homopolymer) spot CFR SE Asia, previously polypropylene (flatyarn) in Asia Pacific Spot CFR SE Asia [from 18 October 2002, previously polypropylene (injection) in Asia Pacific Spot CFR SE Asia] ($/tonne)
- Naphtha in Asia Pacific Spot FOB Singapore (ICIS pricing, Friday assessment) ($/bbl)
- Naphtha in Asia Pacific Spot FOB Singapore (ICIS pricing, weekly average) ($/bbl)
- Propane CFR Japan/Korea (refrigerated cargo) C1 Energy (Thursday assessment) [from 13 June 2014, previously weekly average from 1 November 2010, previously Propane C+F Tokyo Term Spot (Reuters, weekly average)] ($/tonne)
- Butane CFR Japan/Korea (refrigerated cargo) C1 Energy (Thursday assessment) [from 13 June 2014, previously weekly average from 1 November 2010; previously Butane Tokyo C+F Tokyo Term Spot (Reuters, weekly average)] ($/tonne)
- Ethylene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly average) ($/tonne)

- Propylene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly average) ($/tonne)
- Butadiene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly average) ($/tonne)
- Benzene in Asia Pacific Spot FOB SE Asia (ICIS pricing, Friday assessment) ($/tonne)
- Toluene in Asia Pacific Spot CFR SE Asia (ICIS pricing, Friday assessment) ($/tonne)
- Xylene (Solvent Grade) in Asia Pacific spot CFR SE Asia (ICIS pricing, Friday assessment) ($/tonne) [from 5 January 2018]
- Gasoline 95 Unleaded FOB Singapore spot (C1 Energy, weekly average) [from 29 August 2011 to 29 December 2017; previously Gasoline 95 unleaded FOB Singapore cargo spot (Reuters, weekly average)] ($/bbl)
- Fuel Oil 3.5% in Europe Spot CIF Cargoes NWE (weekly average) [from 5 January 2018, previously High Sulphur Fuel Oil mixed/cracked 180 cst FOB Singapore spot (C1 Energy, weekly average) [from 29 August 2011 to 29 December 2017], previously Fuel Oil 180 cst Singapore spot (Reuters, weekly average)] ($/tonne)

MIDDLE EAST

- Polypropylene (Homopolymer) Injection spot CFR GCC, Assessment, 2-4 Weeks, Full Market Range, Weekly ($/tonne)
- Propane contract FOB Ras Tanura (ICIS pricing, $/tonne)
- Butane FOB Ras Tanura Contract Price Assessment, Aramco, Month, Contract Survey, Weekly (ICIS pricing, $/tonne)

INDIA

- Polypropylene Homopolymer Injection spot CFR India, Assessment, Main Ports, 2-4 Weeks, Full Market Range, Weekly ($/tonne)

The methodology associated with each ICIS pricing individual pricing quotation referenced above can be found on the ICIS Compliance and Methodology website.

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

Where price quotations are not available for individual days or weeks due to public holidays, then prior day or week data is carried forward for the specific purpose of populating the model and preventing model inconsistency. This form of data interpolation is inferring some limited data points that may not be market derived, and customers should be aware of this assumption.

All data in the ICIS Weekly Margin – PP Asia model is denominated in US dollars.

POLYPROPYLENE ASIA WEBPAGE

Filter data on the website using the following criteria.

- **Region**: Select either North East Asia, South East Asia, Middle East, India or Inland China.
- **Process**: Select from propane dehydrogenation, LPG steam cracking, naphtha 80/LPG 20 steam cracking, and naphtha steam cracking. Inland China also has the option to view coal-based processes
- **Price terms**: Variable margins are generated for 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 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 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 light olefins variable margin.

PUBLICATION FREQUENCY

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