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Variable Margin Methodology: Polystyrene North America

ICIS
Independent Commodity Intelligence Services

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THE BUSINESS MODEL

ICIS calculate margins for General Purpose Polystyrene (GPPS) and High Impact Polystyrene (HIPS). These products are both ultimately made from ethylene and benzene, and, in the case of HIPS, butadiene. All of these materials originate from naphtha, which in turn comes from crude oil.

The diagram below shows the production process for GPPS. Ethylene is produced at a cracker, which, with benzene and other inputs, is used to produce styrene monomer. This is then polymerised to produce GPPS.

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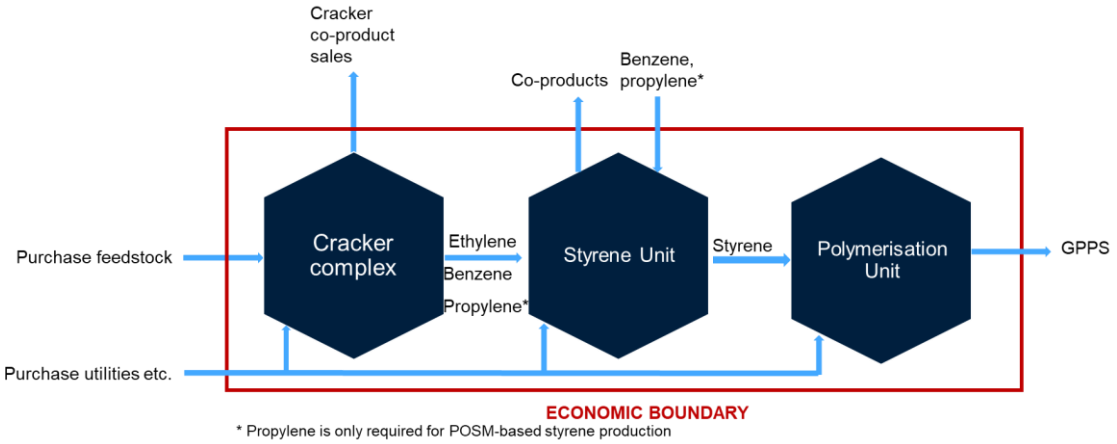
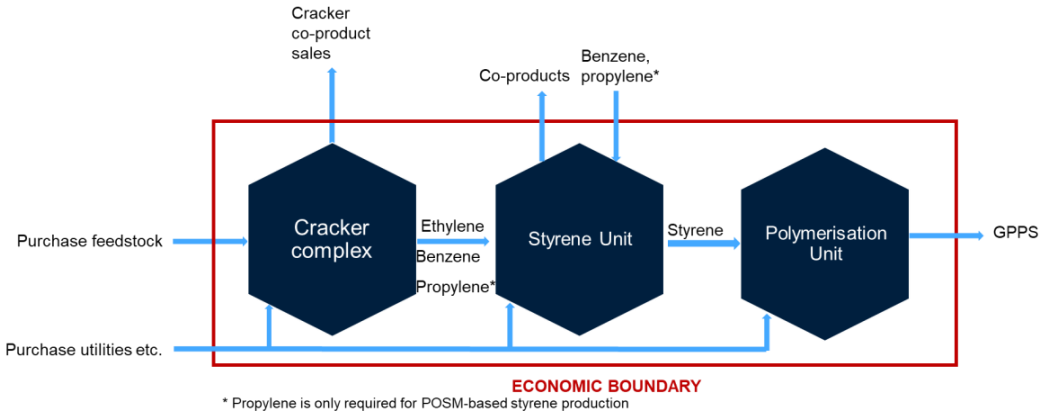


HIPS is produced in a similar way, but styrene is co-polymerised with a small amount of butadiene in the final step.



Both of these diagrams refer to cracker-integrated systems. ICIS has modelled a standalone process for polystyrene, and also polystyrene units only integrated to either POSM or dehydrogenation styrene production units.

THE MARGIN CALCULATION

- The margin measure provides an assessment of the ex-works cash margin obtained or the product over raw material costs, credit for selling co-products, and key variable manufacturing costs, including power and steam, catalysts and chemicals. 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.
- 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 styrene margin for the US Gulf. 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)

GPPS contract price	2,329
Adjustments incl. logistics costs/netbacks	(186)
Styrene product value	**2,143**
Co product sales	96
Total income	**2,239**
Purchase of feedstocks (naphtha, benzene)	763
Utilities	80
Variable costs	**843**

GPPS margin 2,239 – 843 = 1,396

Standalone margin ($/tonne)

GPPS contract price	2,329
Adjustments incl. logistics costs/netbacks	(186)
Styrene product value	**2,143**
Co product sales	0
Total income	**2,143**
Purchase feedstocks (ethylene, benzene)	1,343
Utilities	15
Variable costs	**1,348**

GPPS margin 2,143 – 1,348 = 795

INTEGRATED AND STANDALONE

- Non-integrated or standalone market participants produce styrene only. Our margin model assumes plants that are co-located and that the ethylene and benzene are transferred as part of the process.
- Integrated market participants produce both ethylene and styrene. The business model is to buy ethane or naphtha feedstock, process it into ethylene, benzene and cracker co-products. The balance of benzene is procured from the market. Ethylene and benzene are converted into styrene, which is sold alongside cracker co-products. This business model is applicable to the majority of manufacturing facilities in North America.
- 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 chemical unit operations. Yield pattern data relates to the overall material balance of the cracker unit. For example, for one tonne of GPPS produced, 0.8 - 0.9 tonnes of naphtha feedstock and 0.7 - 0.8 tonnes of benzene are required, which will additionally produce co-products (including,

but not limited to, propylene and butadiene) of 0.3 - 0.5 tonnes (depending on the process). Approximately one tonne of styrene is required to produce a single tonne of polystyrene.

As the dominant cracker feedstock in North America for ethylene, ICIS has selected naphtha as a representative feedstock for cracker-integrated production and therefore best demonstrates the overall margin differences given by integration. Ethylene feedstocks like LPG and methanol are also used in this region, but the effect these different feedstocks have on polystyrene margins are minimal. ICIS has also modelled standalone production for styrene, where ethylene is purchased on the open market.

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 pricing inputs to generate the full content of the ICIS Polystyrene North America margins:

US GULF

- GPPS in US Gulf Contract DEL (cts/lb converted to $/tonne)
- HIPS in US Gulf Contract DEL (cts/lb converted to $/tonne)
- Styrene in US Gulf Contract FOB (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)
- Propylene in US Gulf Contract P Grade (cts/lb converted to $/tonne)
- Butadiene in US Gulf Contract FOB USG (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)
- 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)
- Propylene oxide in US Gulf Contract FOB (cts/lb converted to $/tonne)
- Toluene N Grade in US Gulf Spot FOB (weekly assessment) ($/US gal to $/tonne)
- Mineral Oil, Group I SN150 in US Gulf FOB Spot (weekly average) ($/US gal converted to $/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.

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 – Polystyrene Asia model are denominated in USD unless specifically stated otherwise.

All margins presented are for North America are contract.

POLYSTYRENE US GULF WEBPAGE

Filter data on the website using the following criteria.

- **Process:** Select feedstock source, and from the dehydrogenation and POSM styrene processes.
- **Price terms**: ICIS generates variable margins for contract price terms.

Variable margins data are available online from January 2014 onwards. One year trailing data shows as default.

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

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

PUBLICATION FREQUENCY

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