23 September 2022

Variable Margin Methodology: Styrene Asia

ICIS
Independent Commodity Intelligence Services

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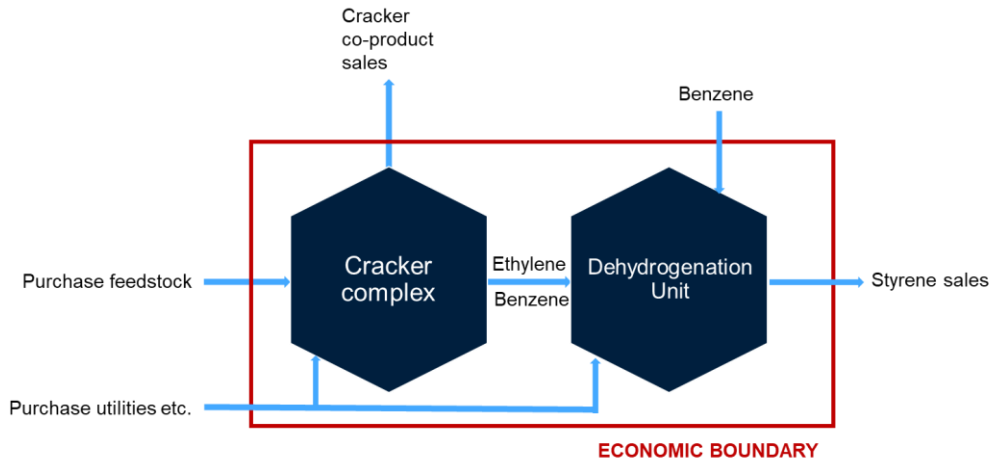
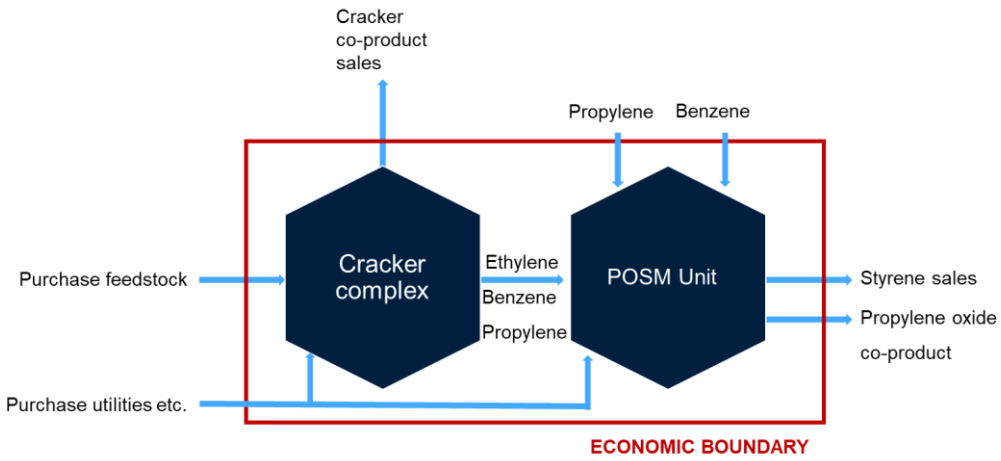
THE BUSINESS MODEL

Styrene is produced from two main processes, dehydrogenation and Propylene Oxide Styrene Monomer (POSM).

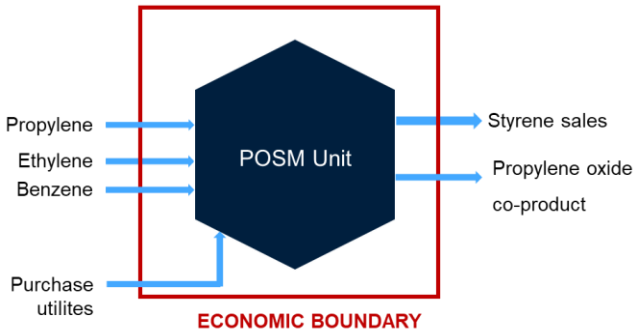
The diagram below shows the dehydrogenation process. Naphtha and steam are fed into a cracker unit, where ethylene and co-products (such as propylene, butadiene and benzene) are made. Ethylene is further processed (catalytic alkylation) with benzene (both from the cracker and bought from the market) to make ethylbenzene. This is then fed into a dehydrogenation reactor to make styrene (with minor co-product toluene and utility coproduct fuel). Styrene is then typically piped to other chemical plants where it is further processed into derivative products such as polystyrene.

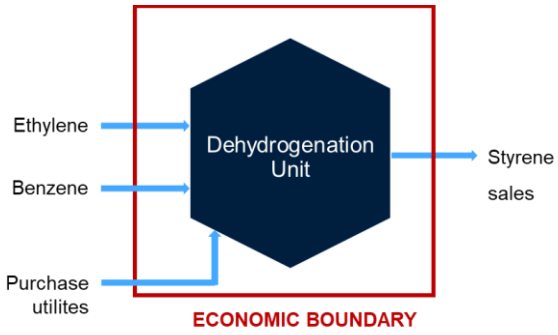


The POSM process uses propylene and oxygen to convert ethylbenzene to styrene, as shown below. Ethylbenzene is produced using conventional alkylation technology from ethylene and benzene as above, and then reacted with propylene and oxygen to produce styrene and propylene oxide.



Both of the above diagrams refer to cracker-integrated systems. ICIS has also modelled a standalone process for both POSM and dehydrogenation, which looks at the styrene units in isolation, as shown below.





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 North East Asia. 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)

Styrene spot price	1,245
Adjustments incl. logistics costs/netbacks	(1)
Styrene product value	**1,244**
Co product sales	251
Total income	**1,495**
Purchase of feedstocks (naphtha, benzene)	1,065
Utilities	69
Variable costs	**1,134**

Styrene margin 1,459 - 1134 = 361

Standalone margin ($/tonne)

Styrene contract price	1,245
Adjustments incl. logistics costs/netbacks	(1)
Styrene product value	**1,244**
Co product sales	33
Total income	**1,277**
Purchase feedstocks (ethylene, benzene)	1008
Utilities	61
Variable costs	**1,069**

Styrene margin 1,277 - 1069 = 208

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 Asia.
- 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, one tonne of styrene requires approximately 0.3 tonnes of styrene and 0.8 tonnes of benzene. Margins will also include any co-products, and cracker-integrated processes will include cracker co-products.

As the dominant cracker feedstock in North East Asia 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. Naphtha has also been modelled to allow comparison with other regions. Ethylene feedstocks like LPG are also used here, but the effect these different feedstocks have on styrene margins is minimal. ICIS has also modelled standalone production, where ethylene is purchased on the open market.

Styrene margins are calculated for the following production processes in Asia:

- Dehydrogenation
- POSM

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 Styrene Asia margins:

NORTHEAST ASIA

- Naphtha in Asia Pacific Spot CFR Japan (ICIS pricing, Friday assessment) ($/tonne)
- Ethylene in Asia Pacific Spot CFR NE Asia (ICIS pricing, weekly average) ($/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 Main China Ports (ICIS pricing, Friday assessment)
- ($/tonne)
- Gasoline 92 Spot CFR China (ICIS pricing, weekly average) ($/bbl)
- 180 CST FOB Singapore Spot (weekly assessment) ($/tonne)
- Propylene Oxide in Asia Pacific Spot CFR China (weekly range) ($/tonne)
- Toluene in Asia Pacific Spot CFR North East Asia (weekly range) ($/tonne)
- Styrene in Asia Pacific Spot CFR North East Asia (weekly range) ($/tonne)

SOUTHEAST ASIA

- Naphtha in Asia Pacific Spot FOB Singapore (ICIS pricing, weekly average) ($/bbl)
- Ethylene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly average) ($/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) ($/tonne)
- Gasoline 95 Unleaded FOB Singapore spot (C1 Energy, weekly average) ($/bbl)
- 180 CST FOB Singapore Spot (weekly assessment) ($/tonne)
- Toluene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly range) ($/tonne)
- Styrene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly range) ($/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 – Styrene Asia model are denominated in USD unless specifically stated otherwise.

All margins presented are for Asia are spot.

STYRENE ASIA WEBPAGE

Filter data on the website using the following criteria.

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

- **Main product value, ex-works**: the estimated styrene 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 – Styrene Asia 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.