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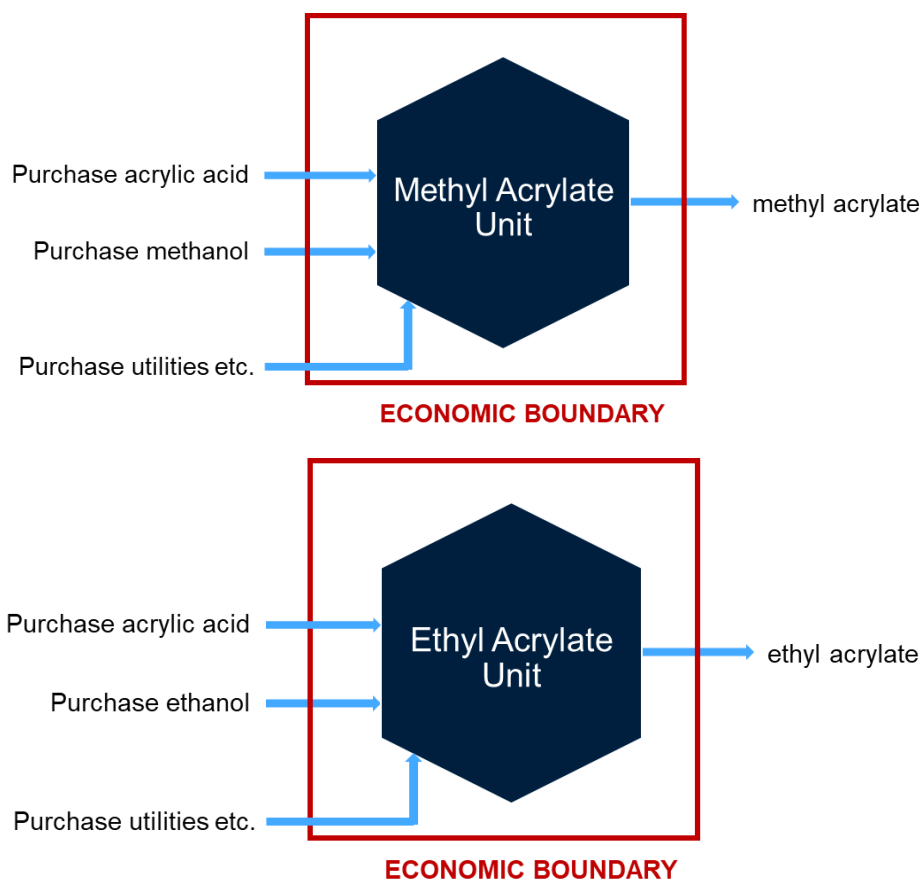
Variable Margin Methodology: Acrylic Acid And Acrylate Esters Asia

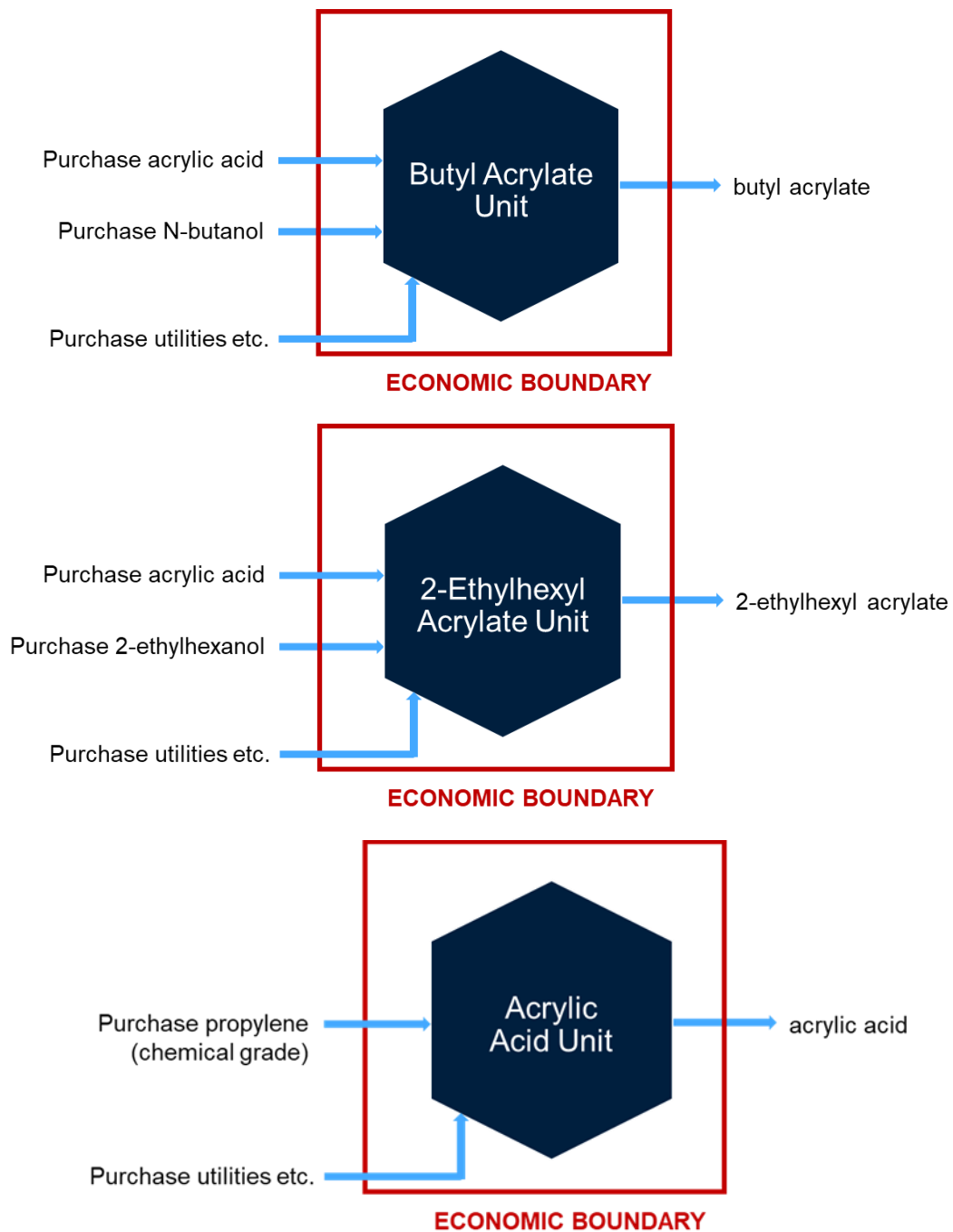
THE BUSINESS MODEL

Acrylate esters are made from the esterification of the corresponding alcohol (or oxo-alcohol) and acrylic acid. Acrylic acid is made from propylene, which undergoes an oxidation reaction.

In this model, the margins for 2-ethylhexyl acrylate, butyl acrylate, ethyl acrylate and methyl acrylate are examined. These require 2-ethylhexanol, N-butanol, ethanol and methanol respectively. The origin of these alcohols varies widely – 2-ethylhexanol and N-butanol are made via the hydroformulation of propylene, while ethanol is made from agricultural sources or from ethylene. Finally, methanol is typically made from natural gas.

ICIS has modelled the esterification process to measure the acrylate ester margins.





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.
- 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 are linked to ICIS pricing quotations for large volume commodity products with netbacks assessed using typical logistic cost assessments.
- 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 acrylic acid margin using a generic esterification process unit in Northeast Asia. The example is based on spot sales prices, is denominated in US dollars per tonne, and uses average prices for the year 2017.



Acrylic Acid margin (\$/tonne)

Acrylic acid spot price	1,322
Logistics costs/netbacks	(2)
Acrylic acid product value	1,320
Utility credits	56
<u>Total income</u>	<u>1,376</u>
Purchase feedstocks (Propylene)	732
Utilities	122
<u>Variable costs</u>	<u>854</u>
<u>Acrylic Acid variable margin</u>	<u>1,376 – 854 = 522</u>

MODEL YIELD PATTERN AND CALCULATION

Plant manufacturing data relates to the variable cost components of the unit's operations. Yield pattern data relates to the overall material balance of the unit. For example, for one tonne of butyl acrylate produced, approximately 0.5 – 0.7 tonnes of acrylic acid is used as feedstock. ICIS calculations also take into consideration additional chemicals and catalysts required for the production of acrylate esters.

Intratec provides the plant manufacturing and feedstock yield data used in the model.

- The acrylate ester margins are calculated for the following production processes:

Northeast Asia:

- Acrylic Acid Ex Propylene (Bulk)
- 2-Ethylhexyl Acrylate ex Acrylic Acid
- Butyl Acrylate ex Acrylic Acid
- Ethyl Acrylate ex Acrylic Acid
- Methyl Acrylate ex Acrylic Acid

Southeast Asia:

- Acrylic Acid Ex Propylene (Drummed)
- 2-Ethylhexyl Acrylate ex Acrylic Acid
- Butyl Acrylate ex Acrylic Acid
- Ethyl Acrylate ex Acrylic Acid



- Methyl Acrylate ex Acrylic Acid
- Due to the different yield patterns when using different feedstocks, a comparative analysis is not a simple case of comparing feedstock price differences, but must take into account co-product credits.
- This analysis demonstrates the volatility of the business and the influence of price floors (as an uneconomic margin generally forces supply reductions).
- Northeast Asian acrylate ester margins are modelled on the following bases:
 - Acrylic Acid - DEL China E basis
 - 2-Ethylhexyl Acrylate - DEL China E
 - Butyl Acrylate - DEL China E
 - Ethyl Acrylate - DEL China E
 - Methyl Acrylate - DEL China E
- Southeast Asian acrylate ester margins are modelled on the following bases:
 - Acrylic Acid - CIF Asia SE basis
 - 2-Ethylhexyl Acrylate - CIF Asia SE
 - Butyl Acrylate - CIF Asia SE
 - Ethyl Acrylate - CIF Asia SE
 - Methyl Acrylate - CIF Asia SE

ASSESSMENT INPUTS

The following pricing inputs are used to generate the full content of the ICIS Acrylic Acid and Acrylate Ester Asia Margins.

NORTHEAST ASIA

- 2-Ethylhexanol in Asia-Pacific Spot Ex-Tank China E (Assessment, 7 days, Close-weighted Range, Weekly, CNY/tonne converted to \$/tonne)
- N-Butanol in Asia-Pacific Spot Ex-Tank China E (Assessment, 7 days, Close-weighted Range, Weekly, CNY/tonne converted to \$/tonne)
- Ethanol in Asia Pacific Spot CFR Asia NE (Hydrous, Min 95% Purity, Assessment, 3rd Month, Full Market Range, Weekly, \$/cbm converted to \$/tonne)
- Methanol in North East Asia, Spot Ex-tank East China (Daily, CNY/tonne converted to \$/tonne)



- Acrylic Acid in Asia Pacific DEL China E (Glacial, Assessment, Bulk, 0-10 Days, Close-weighted Range, Weekly, CNY/ tonne converted to \$/tonne)
- 2-Ethylhexyl Acrylate in Asia-Pacific Spot DEL China E (Assessment, Close-weighted Range, Bulk, Weekly, CNY/ tonne converted to \$/tonne)
- Butyl Acrylate in Asia-Pacific Spot DEL China E (Assessment, Close-weighted Range, Bulk, Weekly, CNY/ tonne converted to \$/tonne)
- Ethyl Acrylate in Asia-Pacific Spot DEL China E (Assessment, Close-weighted Range, Bulk, Weekly, CNY/ tonne converted to \$/tonne)
- Methyl Acrylate in Asia-Pacific Spot DEL China E (Assessment, Close-weighted Range, Bulk, Weekly, CNY/ tonne converted to \$/tonne)
- Propylene in Asia Pacific Spot CFR NE Asia (ICIS pricing, weekly average, \$/tonne)

SOUTHEAST ASIA

- 2-Ethylhexanol in Asia-Pacific Spot CFR Asia E (Assessment, Main Ports Dutiable, Full Market Range, Weekly, \$/tonne)
- N-Butanol in Asia Pacific Spot CFR Asia SE (Assessment, 2-6 Weeks, Full Market Range, Weekly, \$/tonne)
- Ethanol in Asia Pacific Spot CFR Asia SE (Anhydrous, Min 99.5% Purity, Assessment, 2nd Month, Full Market Range, Weekly, \$/cbm converted to \$/tonne)
- Methanol in Asia Pacific, CFR SEA (Weekly, \$/tonne)
- Acrylic Acid in Asia Pacific CIF Asia SE (Glacial, Assessment, Import, Drummed, 0-4 Weeks, Full Market Range, Weekly, \$/tonne)
- 2-Ethylhexyl Acrylate in Asia-Pacific Spot CIF Asia SE (Assessment, Import, Iso-Container, 0-4 Weeks, Full Market Range, Weekly, \$/tonne)
- Butyl Acrylate in Asia-Pacific Spot CIF Asia SE (Assessment, Import, Iso-Container, 0-4 Weeks, Full Market Range, Weekly, \$/tonne)
- Ethyl Acrylate in Asia-Pacific Spot CIF Asia SE (Assessment, Import, Iso-Container, 0-4 Weeks, Full Market Range, Weekly, \$/tonne)
- Methyl Acrylate in Asia-Pacific Spot DEL China E (Assessment, Import, Iso-Container, 0-4 Weeks, Full Market Range, Weekly, \$/tonne)
- Propylene in Asia Pacific Spot CFR Asia SE (ICIS pricing, weekly average, \$/tonne)

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



In addition to the listed ICIS pricing inputs, the model also takes into account logistic costs (calculated through the ICIS logistics model), and utilities 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 – Acrylic Acid and Acrylate Esters Asia model are denominated in USD unless specifically stated otherwise.

ACYLIC ACID AND ACRYLATE ESTERS ASIA WEBPAGE

Filter data on the website using the following criteria.

- **Area:** Select Northeast Asia or Southeast Asia.
- **Acrylate Ester:** Select Acrylic Acid, 2-Ethylhexyl Acrylate, Butyl Acrylate, Ethyl Acrylate or Methyl Acrylate.
- **Process type:** Select the corresponding process.
- **Price terms:** Variable margins are generated for spot price terms only in Asia.
- **Frequency:** Viewable with weekly, monthly, quarterly, or yearly granularity.
- **Currency:** Allows prices to be displayed in either EUR or USD.
- **Unit:** Allows conversion from displayed unit to unit of choice in data download only.

Variable margins data are available online from January 2014 onwards. Twelve months trailing data shows as default.

The website deploys the following data, all per tonne of acrylate ester:

- **Main product value, ex-works:** the estimated acrylate ester 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 acrylate ester variable margins.

PUBLICATION FREQUENCY

The ICIS Weekly Margin – Acrylic Acid and Acrylate Esters Asia model is based on the latest data at the close of business in UK 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. Updates are not published on some public holidays. Holiday dates and days of publication may be subject to revision.