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Variable Margin Methodology: Polyethylene Asia

ICIS
Independent Commodity Intelligence Services

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THE BUSINESS MODEL

Polyethylene (PE) is produced via the polymerisation of ethylene. The main feedstocks for polyethylene in Asia are naphtha, liquefied petroleum gas (LPG), methanol.

Naphtha is a product mainly derived from crude oil. Naphtha and steam are fed into a cracker unit where ethylene and other co-products (such as propylene, butadiene and benzene) are made. Ethylene is separated from co-products and piped to a PE plant, where it is further processed (polymerised) to make PE pellets for sale. Co-products are separated and sold for use in other chemical plants, or used for fuel.

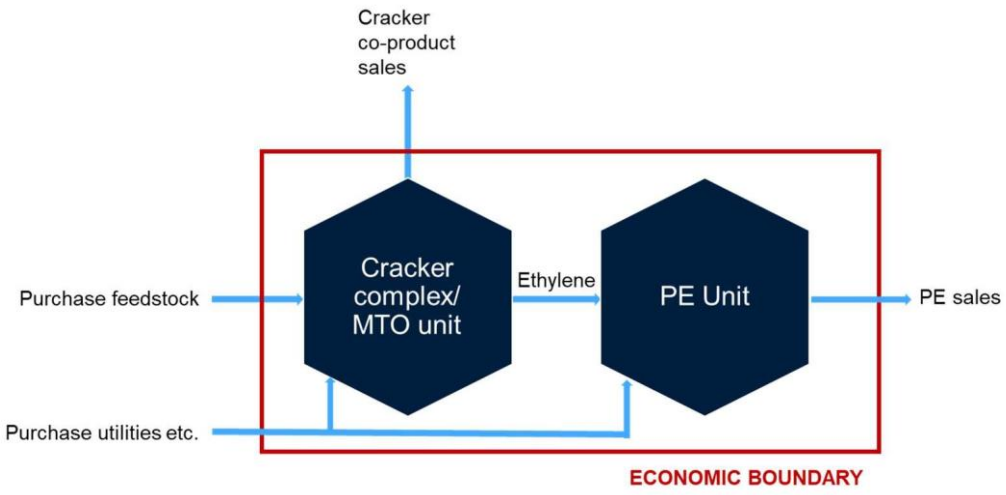
LPG can be derived from gas separation processes and as a by-product of refinery processes. It is cracked with steam, in a similar way to naphtha, but the co-product slate is different and generally lighter than naphtha, with ethylene and propylene produced along with smaller amounts of co-products.

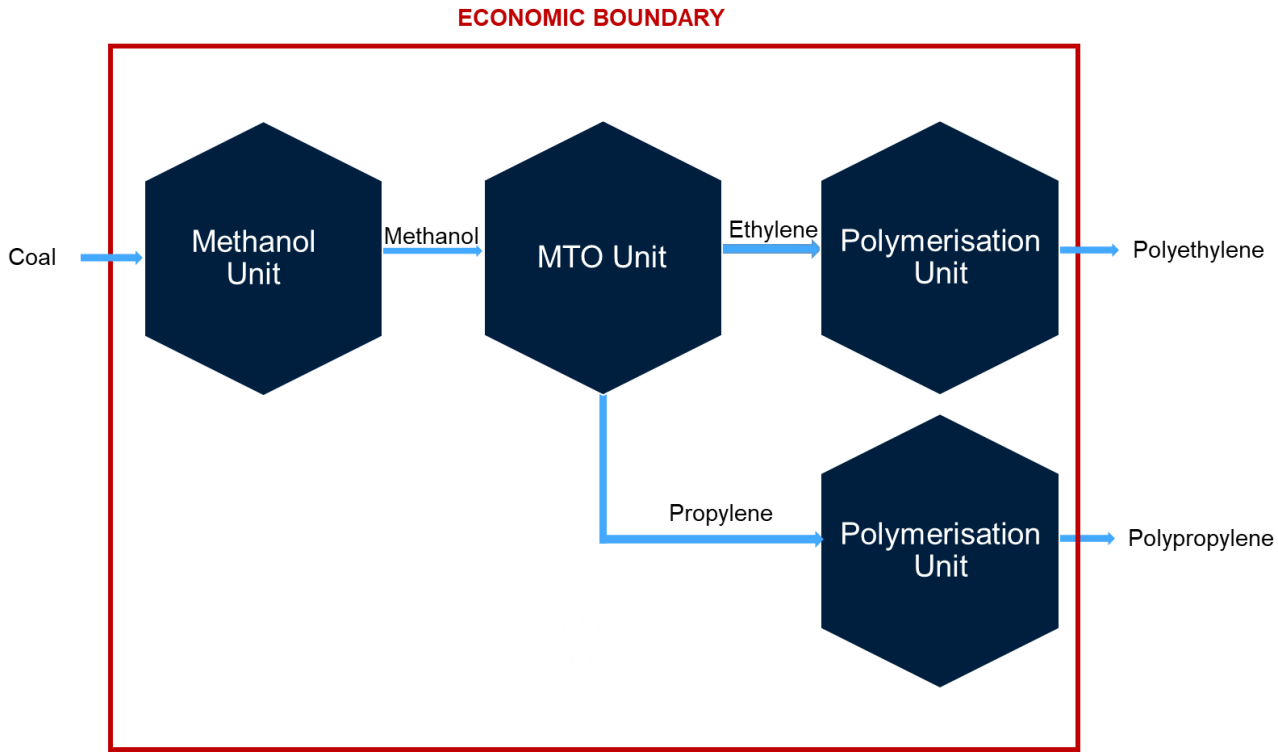
Methanol is also an important feedstock in this region, particularly in China. Here, methanol is produced mostly from coal. Methanol to Olefins (MTO) technology produces light olefins (ethylene and propylene) with few co-products.

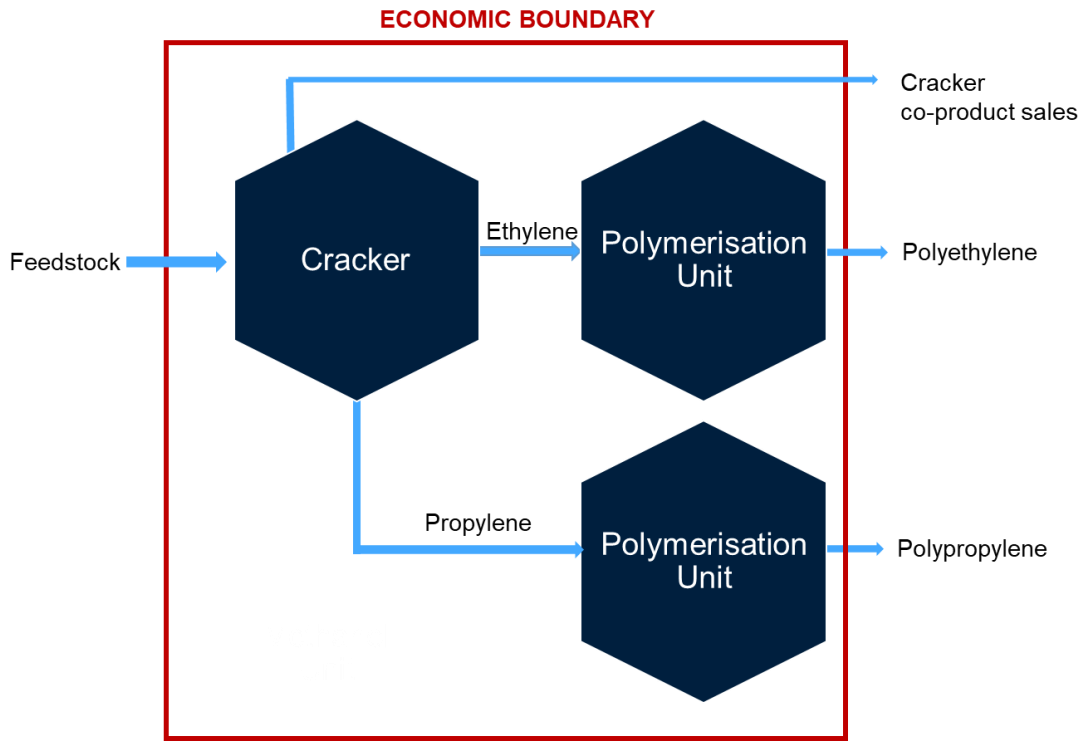
ICIS also models polyethylene units integrated back to coal, via the MTO method.

ICIS models the variable margin for polyethylene from the Middle East. Most crackers in the Middle East use ethane or LPG as a feedstock. Ethylene is the major product, and overall this yields a much lighter product slate than other heavier feedstocks.

Indian polyethylene margins have also been modelled for a naphtha cracker.







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.
- In Southeast Asia, ICIS models naphtha and LPG feedstocks to represent ethylene production. In Northeast Asia, ICIS also models methanol due to its use in China in the MTO process. As such, the cost model is broadly applicable to the majority of the Asian commodity PE business. ICIS also models PE margins for the Middle East, taking into consideration an integrated ethane cracker.
- For naphtha-based polyethylene margin calculations for LPG-based margins in the Middle East, polypropylene values have been used to calculate co-product contributions, in place or propylene. Production costs of the propylene polymerization step have been included into the overall margin calculation, but only for these two processes.

- 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 PE grades referenced in the ICIS PE Asian Margin report are low density polyethylene (LDPE) film grade, high density polyethylene (HDPE) injection moulding grade and linear low density polyethylene (LLDPE) film grade. These represent the large volume commodity grades in the PE market.

The calculation below shows how ICIS derives the LDPE margin (feedstock naphtha) for 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.

Naphtha-based integrated margin ($/tonne)

LDPE spot price	1,207
Logistics costs/netbacks	(1)
LDPE product value	**1,206**
Co product sales	**1,035**
Total income	**2,241**
Purchase feedstock (naphtha)	1,561
Utilities	176
Variable costs	**1,737**
LDPE margin	**2,241 - 1,737 = 504**

Standalone margin ($/tonne)

LDPE spot price	1,207
Logistics costs/netbacks	(1)
LDPE product value	**1,206**
Co product sales	**21**
Total income	**1,227**

Purchase feedstock (ethylene)	1,216
Utilities	117
Variable costs	**1,334**

LDPE margin **1,227 - 1,334 = -107**

Note:

- This calculation assumes the use of 1.01 tonnes of ethylene to produce one tonne of LDPE.

- The model assumes 4.4 tonnes of coal are required to make one tonne of PP/PE.

INTEGRATED AND STANDALONE

- Non-integrated or standalone market participants produce PE only. Our margin model assumes plants are co-located and that ethylene is transferred as part of the process.

- Standalone analysis, which considers the polymer unit in isolation, helps to identify marginal opportunities, e.g. where ethylene could be more profitably used for other ethylene derivative products. No standalone analysis is performed for Middle Eastern or Indian margins.

- Integrated market participants produce both ethylene and PE. The business model is to buy feedstock, process it into ethylene and cracker co-products, convert the ethylene into PE, and sell both the PE and cracker co-products. This business model is applicable to the majority of manufacturing facilities in Asia.

- Most Asian PE plants are integrated with cracker sources of ethylene. These 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.

- The margin is therefore measured across the supply chain from feedstock through to PE and any co-products.

- Analysis of integrated plants demonstrates business volatility and the influence of price floors, which can lead to an uneconomic integrated margin, and generally force a reduction in supply.

MODEL YIELD PATTERN AND CALCULATION

Plant manufacturing data relates to the variable cost components of cracker operations. Yield pattern data relates to the overall material balance of the cracker unit. For example, for one tonne of ethylene produced, a cracker will use approximately three tonnes of naphtha as feedstock. In addition to the one tonne of ethylene, the cracker will produce co-products (including propylene, butadiene, benzene, raffinate-1, pygas, fuel oil and fuel gas). ICIS calculations also take into consideration additional chemicals and catalysts required for the synthesis of PE.

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

- Naphtha, LPG, and methanol are the dominant feedstocks in Asia.
- For each PE product (LDPE, HDPE, LLDPE), Asian polyethylene margins are calculated for the following production processes:

  Northeast Asia:
  - HDPE:
    - Methanol HDPE Solution
    - LPG HDPE Solution
    - Naphtha HDPE Solution
    - Standalone HDPE Solution
  - LLDPE:
    - Methanol LLDPE Solution
    - LPG LLDPE Solution
    - Naphtha LLDPE Solution
    - Standalone LLDPE Solution
  - LDPE:
    - Methanol LDPE High Pressure Tubular
    - LPG LDPE High Pressure Tubular
    - Naphtha LDPE High Pressure Tubular
    - Standalone LDPE High Pressure Tubular

  Southeast Asia:
  - HDPE:
    - LPG HDPE Solution
    - Naphtha HDPE Solution
    - Standalone HDPE Solution
  - LLDPE:
    - LPG LLDPE Solution
    - Naphtha LLDPE Solution
    - Standalone LLDPE Solution

- LDPE:
    - LPG LDPE High Pressure Tubular
    - Naphtha LDPE High Pressure Tubular
    - Standalone LDPE High Pressure Tubular

Middle East Gulf

- HDPE
    - Ethane HDPE Solution
    - LPG HDPE Solution, Polypropylene
- LLDPE
    - Ethane LLDPE Solution
    - LPG LLDPE Solution, Polypropylene
- LDPE
    - Ethane LDPE High Pressure Tubular
    - LPG LDPE High Pressure Tubular, Polypropylene

Inland China

- Coal HDPE Solution
- Coal LLDPE Solution
- Coal LDPE High Pressure Tubular

India

- Naphtha HDPE Solution
- Naphtha LLDPE Solution
- Naphtha LDPE High Pressure Tubular

- 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 Asia is modelled on a CFR China basis.
- Southeast Asia is modelled on a CFR Southeast Asia basis.
- Inland China one an Ex-Works basis.
- Middle East is modelled on a CFR GCC basis.
- India is modelled on a CFR India basis.

ASSESSMENT INPUTS

The following pricing inputs are used to generate the full content of the ICIS Polyethylene Asia margins:

NORTHEAST ASIA

- Polyethylene LDPE (film) in Asia Pacific Spot China (ICIS pricing, Friday assessment) ($/tonne)
- Polyethylene HDPE (injection) in Asia Pacific Spot China (ICIS pricing, Friday assessment) ($/tonne)
- Polyethylene LLDPE (film) in Asia Pacific in Asia Pacific spot CFR China (ICIS pricing, Friday assessment) ($/tonne)
- Naphtha in Asia Pacific Spot CFR Japan (ICIS pricing, Friday assessment) ($/tonne)
- Propane spot CFR Japan/Korea (refrigerated cargo) C1 Energy (Thursday assessment) ($/tonne)
- Butane spot CFR Japan/Korea (refrigerated cargo) C1 Energy (Thursday assessment) ($/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 ($/tonne)
- 180 CST FOB Singapore Spot (weekly assessment) ($/tonne)

INLAND CHINA

- Coal in China Spot Ex-Works, thermal coal, (Weekly, CNY/tonne).
- HDPE in China Spot Ex-Warehouse, China N (ICIS pricing, Weekly, CNY/tonne)
- LDPE in China Spot Ex-Warehouse, China N (ICIS pricing, Weekly, CNY/tonne)
- LLDPE in China Spot Ex-Warehouse, China N (ICIS pricing, Weekly, CNY/tonne)

SOUTHEAST ASIA

- Polyethylene LDPE (film) in Asia Pacific Spot Southeast Asia (ICIS pricing, Friday assessment) ($/tonne)
- Polyethylene HDPE (injection) in Asia Pacific Spot Southeast Asia (ICIS pricing, Friday assessment) ($/tonne)
- Polyethylene LLDPE (film) in Asia Pacific spot CFR Southeast Asia (ICIS pricing, weekly average) ($/tonne)
- Naphtha in Asia Pacific Spot FOB Singapore (ICIS pricing, Friday assessment) ($/bbl)
- Naphtha in Asia Pacific Spot FOB Singapore (ICIS pricing, weekly average) ($/bbl)
- Propane CFR Japan/Korea (refrigerated cargo) C1 Energy (Thursday assessment) ($/tonne)
- Butane CFR Japan/Korea (refrigerated cargo) C1 Energy (Thursday assessment) ($/tonne)
- Ethylene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly average) ($/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) ($/tonne) [from 5 January 2018]
- Fuel Oil 3.5% in Europe Spot CIF Cargoes NWE (weekly average) ($/tonne)
- 180 CST FOB Singapore Spot (weekly assessment) ($/tonne)

MIDDLE EAST

- Ethane spot FOB Saudi Arabia (ICIS monthly pricing) ($/tonne)
- HDPE Blow Moulding spot CFR GCC Assessment, 2-4 Weeks, Full Market Range, Weekly ($/tonne)
- LDPE Film spot CFR GCC Assessment, 2-4 Weeks, Full Market Range, Weekly ($/tonne)
- LLDPE Film spot CFR GCC Assessment, 2-4 Weeks, Full Market Range, Weekly ($/tonne)
- Polypropylene Homopolymer Injection CFR GCC, Assessment, 2-4 Weeks, Full Market Range, Weekly
- Propane FOB Ras Tanura Contract Price Assessment, Aramco, Month, Contract Survey, Weekly
- Butane FOB Ras Tanura Contract Price Assessment, Aramco, Month, Contract Survey, Weekly

INDIA

- HDPE Injection spot CFR India, Assessment, Main Ports, 2-4 Weeks, Full Market Range, Weekly
- LLDPE Film spot CFR India, Assessment, Main Ports, 2-4 Weeks, Full Market Range, Weekly
- LDPE Film spot CFR India, Assessment, Main Ports, 2-4 Weeks, Full Market Range, Weekly
- Propylene in Asia Pacific Spot CFR SE Asia (ICIS pricing, weekly average) ($/tonne)

The propylene price in India is calculated using the CFR Southeast Asia price with a logistics consideration.

The methodology associated with each individual ICIS 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 – Polyethylene Asia model are denominated in USD unless specifically stated otherwise.

POLYETHYLENE ASIA WEBPAGE

Filter data on the website using the following criteria.

- **Area**: Select from Northeast Asia, Southeast Asia, Middle East Gulf, Inland China and India.
- **Process type**: Select for each PE grade:
  - **HDPE**: Ethane HDPE solution (Middle East Gulf only), LPG HDPE solution, naphtha HDPE solution, standalone HDPE solution, methanol HDPE solution, coal-based (for Inland China only), LPG HDPE Solution Polypropylene (Middle East Gulf only)
  - **LDPE**: Ethane LDPE high pressure tubular (Middle East Gulf only), LPG LDPE high pressure tubular, naphtha LDPE high pressure tubular, standalone LDPE high pressure tubular, methanol LDPE high pressure tubular, coal-based (for Inland China only), LPG LDPE high pressure tubular Polypropylene (Middle East Gulf only)
  - **LLDPE**: Ethane LLDPE solution (Middle East Gulf only), LPG LLDPE solution, naphtha LLDPE solution, standalone LLDPE solution, methanol LLDPE solution, coal-based (for Inland China only) LPG LLDPE Solution Polypropylene (Middle East Gulf only)
- **Price terms**: Variable margins are generated only for spot price terms.

- **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. Six months trailing data shows as default.

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

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

PUBLICATION FREQUENCY

The ICIS Weekly Margin – Polyethylene 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. Updates are not published on some public holidays. Holiday dates and days of publication may be subject to revision.