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ICIS Cost Curves Methodology – Monoethylene Glycol

Independent Commodity Intelligence Services

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Calculating Cost of Production

The costs displayed are calculated on a per metric tonne of reference product (for example, per tonne of ethylene for the ethylene cost curve) basis, assuming a 100% operating rate. They are determined on a weekly basis.

This means that for an ethylene plant with the capacity to produce 10,000 tonnes in a week, the total cost figure displayed on the ethylene cost curve will be the total cost of running the entire plant (assuming 10kt of ethylene is produced) divided by 10,000.

The major sub-categories we use for total costs are ‘variable’ and ‘fixed’ costs.

Variable Costs

We calculate variable cost of production using a detailed description of the process. We apply reported prices (subject to specific localisation adjustments where required) to evaluate the total cost/value of each input/output stream.

Excluding the reference product for the cost curve under consideration, we subtract the total value of co-products produced from the combined cost of feedstock inputs, process catalysts/chemicals and utilities required. The remainder is the variable cost.

All variable costs displayed in the tool are calculated on an ex-works basis. This means that, especially for relatively isolated plants and for difficult to transport commodities, the costs displayed are not necessarily directly comparable to pricing with incoterms like FOB, CFR or similar.

Local Pricing and Logistics

Where there is no reported price series covering the location of a plant, we estimate a modified price based on the most representative reported price.

To do this, we use an estimate of the cost of shipping the relevant commodity between the plant location and the location covered by the price series. Then, based on the local supply and demand balance for the commodity, we estimate an adjusted price series at that plant from the reported price and the shipping cost. This adjusted series is used in the variable cost calculation for that plant.

Negative Variable Costs

Using this definition, calculated variable costs for the main product in a process are typically positive – meaning that the cost of all inputs is more than the value of all co-products.

Occasionally, one or more co-products can have a sufficiently high value relative to the cost of inputs to give negative variable costs for the main product. For example, for ethylene production in a steam cracker, if propylene has a very high value relative to LPG or naphtha negative costs can be observed for ethylene. A situation like this existed for several US Gulf steam crackers in February 2021.

Negative variable costs are also seen where the reference product of a cost curve is normally considered a co-product for a plant. In the case of a steam cracker, when

constructing a propylene cost curve, ethylene becomes considered as a co-product. This means that for an efficient unit, a strong margin can be achieved before propylene is accounted for and therefore costs can be strongly negative.

Negative costs for a particular product imply that, everything else staying the same, the plant would continue to produce regardless of the price of that product (or, more precisely: they will, in the absence of logistical/technical/inventory constraints).

Fixed Costs

We estimate the fixed costs for each plant in a generic way.

These estimates exclude financing and depreciation costs, because these can vary so much between different plants and producers.

We break down the fixed costs associated directly with the operations of the plant, into the following categories, which we estimate in the following way:

Fixed costs category	**Method of calculation**
Operating labour	Country-level index scaled by number of people
Supervising labour	Country-level index scaled by number of people
Maintenance cost	Percentage of total plant cost
Operating charges	Percentage of labour costs
Plant overhead	Percentage of maintenance + labour costs
Property taxes and insurance	Percentage of fixed capital per year
Administration costs	Percentage of maintenance + op. labour costs

To produce these estimates, we need to be able to estimate the fixed capital costs of each plant.

We do this using a series of reference plants for each technology type. For these reference plant examples, we record when and where they were built and their nameplate capacity, with estimates of the ISBL and OSBL fixed capital costs. These are used to generate an estimate of the total cost of a plant.

We then apply a series of factors, updated monthly, to estimate the relative cost of plant construction over time, and between different countries. Additionally we make assumptions about how changing capacity (and, where relevant, feedstock flexibility) changes the total cost. This allows us to localise the generic fixed capital estimate to specific plants.

We then apply the factors mentioned above to this localised estimate to give the ongoing costs applicable to each of the categories listed above, these are divided by the nameplate capacity of the plant over a given period to estimate the fixed contribution to the cost of production.

Cost Curve

We build the cost curve displayed in the tool by ranking the units in order of total cost, from low to high. The height of each bar is based on this cost of production, marked in $/tonne on the y-axis and divided into variable and fixed costs.

The width of each bar (on the x-axis) is equal to its capacity for the reference period. Because plants are placed in succession, this means that the starting position of a plant on the x-axis is equal to the cumulative capacity of all the plants with a lower total cost of production than it.

Marginal producer and Price Ceiling

We use the cost curve produced from the plants in a region to illustrate some of the underlying drivers and limitation on price formation in a region. To do this, we compare the curve to the supply and demand fundamentals of that region and to the situation in other regions which are important to price formation in the region.

Typically we show the price floor as being the total operating cost for the marginal producer in a region. The marginal producer is the producer who, when ranked in order of increasing total cost, has the cumulative capacity equal to the trade adjusted demand for that region (see below). This is the producer who the demand line intersects with when drawn on the cost curve.

The ‘price ceiling’ is the level above which prices will not easily rise. This can be due to high prices restricting demand or incentivising to arrival of new supply from a different region/area, causing the market to lengthen.

We represent this by the influence of other regions, with the potential for additional incremental import supply or reduced export demand to or from other regions acting as a likely cap on the upward movement of a price.

The ceiling is based on the price in a region with the potential to supply greater export volumes or an importing region which could receive less, plus the estimated cost of moving material from that region to the location of the price.

For an exporting region, the level at which exports cease to offer a sufficient netback to importing regions is used in setting the ‘price ceiling’. For an importing region, the level at which additional suppliers, from other regions, will be incentivised to offer new volumes serves the same function.

Price Window

Together the floor and ceiling form a kind of ‘window’, within which, we would typically expect market prices to fall.

This is not always the case, because of factors like rapid changes in markets, severe supply limitations or problems with logistics and infrastructure which are not wholly captured in our existing models.

To assess a market's status in relation to these limits, we generally use a spot price. This is because, in comparison to contract and domestic pricing, prices of this sort are more responsive to market changes, do not include implied discounts and are typically quoted on a more internationally comparable basis (e.g. FOB/CFR/etc. rather than FD/DEL).

The prevailing position of the price relative to the 'price floor' and 'price ceiling' is different from region to region and can change significantly over time. However, in general, we can see certain patterns:

- Exporting markets typically have higher prices relative to their windows than importing regions. This is because the exporter market usually has lower costs of production but sees their price (and price ceiling) influenced by the pricing of another region, typically with higher local costs and prices.
- The reverse is normally true for an importing region, where the price is constrained by the role of imports and at least some local producers have relatively high costs of production.

The 'price floor' and 'price ceiling' can be useful for understanding how sustainable prices are likely to be or for estimating how much further a rising or falling price might be able to move.

Regional Demand and Trade Flows

Understanding the level of regional demand, inter-regional trade and how these change over time allows cost curves to be used for more detailed market analysis.

We start with the annual estimates for demand and inter-regional trade from the ICIS Supply and Demand Database. These are changed into weekly series by assuming a steady gradual change between years.

Currently, we do not directly apply short-term trade or production data to attempt to make more specific, sub-annual, estimates for the evolution of these quantities. This is because these short-term datasets can be inconsistent.

In addition, short-term variation in these statistics can frequently overstate the size of instability in the absence of a comprehensive view of inventory changes.

We take the resulting demand and trade series, combining them into a 'trade-adjusted demand' series. This aims to represent the demand available to local producers and is equivalent to the local demand plus any net export or minus any net import. For a net exporting region, like the US in polyethylene, the adjusted demand will be more than the local demand.

This 'trade-adjusted demand' is the appropriate quantity to compare to a cost curve of producers to generate the derived datasets discussed above.

Integration

Where a petrochemical product serves as a feedstock for a modelled process, and that product can be supplied by another adjacent plant under common ownership, we consider that the units are integrated.

This means that the product will not be valued at the market price for the consuming unit.

For example, if a polyethylene unit is located next to a cracker, operated by the same company, the PE unit will value the incoming ethylene, based on the cost of production for the upstream unit.

Therefore derivative units attached to advantaged upstream units can have much lower costs than comparable standalone units.

Where more than one relevant upstream unit is present, or where some feedstock is being purchased, we use a volume weighted average of the value from the different sources to give the input value for the derivative unit.

In the case of petrochemical units with direct integration to refineries or specific refinery units we do not calculate a transfer price based on production economics. This is because the economics of refinery operations are beyond the scope of this model. It also reflects the fact that margins for refined products are typically more liquid than for chemical intermediates.

Update Frequency

The tool is updated weekly, following the publication of major ICIS prices used in the model calculations.

Updated data based on the previous week's pricing information should normally be available by close-of-business GMT each Monday.

Historical Data

Users can select several years' worth of historical weekly cost curves for comparison and historical analysis.

These will be subject to revision where inputs change. In particular, our supply and demand inputs will be revised over time as new reported data becomes available.

Impact of Plant Maintenance and Outages

Where plants are not operating for part or all of a week, this is reflected in a change to their 'available capacity' for that period. If a plant is considered to be non-operational for 3 days during a week, then the capacity used in the cost curve will be scaled by four-sevenths.

Plants that are down for the whole of a week will not appear in that week's cost curve when available capacity is selected.

The additional costs of carrying out periodic plant maintenance are reflected as part of the fixed costs of each plant. Presently, this is done uniformly for all plants, without reference to the frequency or length of maintenance events at a specific plant.

Known outages are added to the tool each week, when plant costs are calculated. During each week, more recent information may be available in the ICIS Live Supply Disruptions Tracker, which is updated intra-daily.

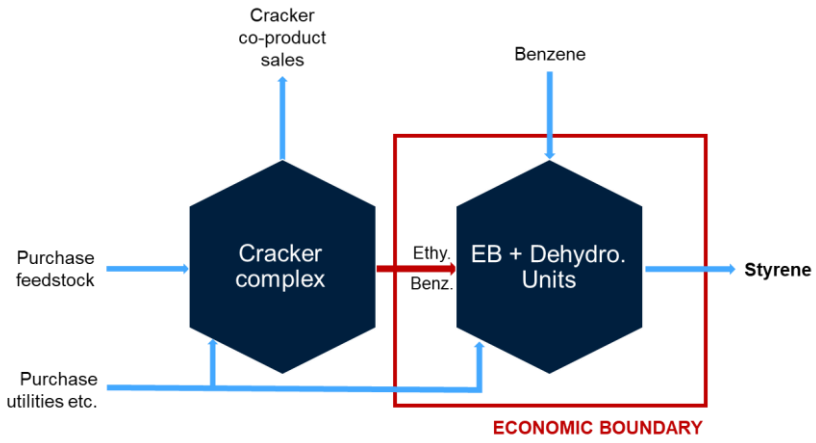
Cracker Flexibility

Cracker flexibilities are represented in our cost curve calculations with a calculated, optimal mix of processes for each steam cracker.

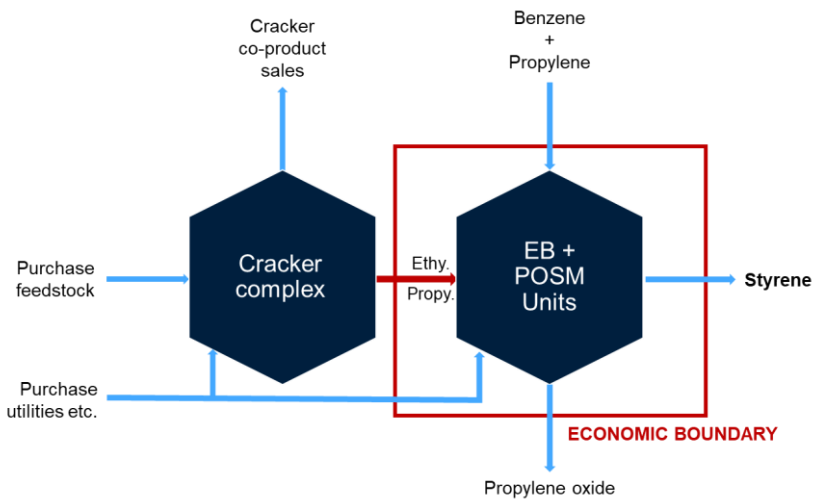
ICIS collect data tracking the estimated flexibilities of each cracker. We optimise feedstock mixture, based on the expected cost of each process mix for each cracker to produce a weekly 'ideal' configuration for each unit, which is reflected in the variable cost of production displayed in the curve.

Major Technology and Process Archetypes Present

Styrene production via ethylbenzene by dehydrogenation, various levels of integration.



Styrene production via ethylbenzene by POSM, various levels of integration.



Regional reference prices – monoethylene glycol

North America:

Spot, Assessment, Barges, Prompt, Full Market Range, Weekly, FOB, USG

Europe:

Spot, Assessment, T2, Prompt, Full Market Range, Weekly, FCA, NWE

Northeast Asia:

Spot, Assessment, 0-8 Weeks, Weighted Average, Weekly, CFR, China Main Ports