

# Polystyrene Europe Margin Report Methodology

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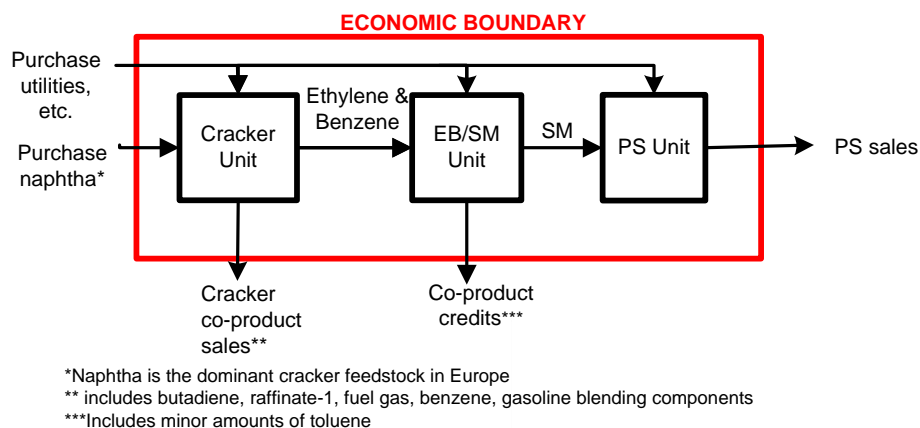


This document is intended to provide methodology support for customers receiving the ICIS Margin – PS Europe report.

## THE BUSINESS MODEL

The diagram below shows the main method of making polystyrene (PS) from naphtha, a product mainly derived from crude oil.

Naphtha with steam is fed into the cracker unit where ethylene and co-products (propylene, butadiene, benzene, etc.) are made. The ethylene and benzene from the cracker are then further processed (catalytic alkylation) to make ethylbenzene. This is then fed into a dehydrogenation reactor to make styrene (with minor co-product toluene and fuel byproduct). The styrene is then polymerised (with a small amount of mineral oil) to produce general purpose polystyrene (GPPS), or polymerised with a small percentage of polybutadiene to produce high impact polystyrene (HIPS).



## THE MARGIN CALCULATION

- Margin measure provides assessment of the ex-works cash margin obtained for the product over raw material costs and key variable manufacturing costs, such as power, steam, catalysts and chemicals. This measure can also be termed as a variable margin, contribution or benefit.
- It represents a cash margin measure available for supporting the direct and allocated fixed manufacturing costs, working capital, taxes, royalties, corporate costs, debt service costs, capital costs and owner's returns from the business, which are not included.

- This margin measure provides simple signals on the direction of business margins, as dictated by the environment alone, thus informing market positioning by sellers, buyers and traders.
- ICIS chooses not to model beyond raw material costs and key variable manufacturing costs as this ceases to be generic to the integrated industry and 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.
- Plant manufacturing and feedstock yield model data have been provided for the cracker unit by Linde Engineering, a division of Linde AG. Linde Engineering ([www.linde-engineering.com](http://www.linde-engineering.com)) is a leading international chemical plant designer, process engineering, procurement and construction contractor. It has extensive experience in ethylene plant design.
- The process model is generic and not referenced to any individual operation, so that the contribution measure is only indicative. It can be most valuably referenced in index and step change terms as opposed to absolute value terms.
- Ex-works product price assessments are linked to ICIS pricing quotations for large volume commodity products with netbacks assessed using typical logistic cost assessments.

Below is a detailed calculation of how the GPPS margin is calculated. The figures refer to averages for contract sales values for 2009; the calculation for spot sales values is similar. Figures indicated in red are those found in the tables of the margin report; others relate to underlying assumptions of the model.

## GPPS integrated margin calculation (€/tonne) – averaged for 2009

GPPS domestic price	1,050	
Logistics costs/netbacks	<u>(239)</u>	
Net selling price		811
Purchase feedstock (naphtha) <sup>1</sup>	(355)	
Benzene (from the cracker)	(356)	
Mineral oil	(20)	
Co-product sales/tonne of GPPS produced <sup>2,3</sup>	244	
Variable cost of ethylbenzene/styrene/PS units <sup>4</sup>	<u>(114)</u>	
		(601)
<b>Integrated margin</b>		<b>210</b>

## Standalone margin calculation (€/tonne) – for 2009

GPPS price	1,050	
Logistics costs/netbacks	<u>(239)</u>	
Net selling price		811
Styrene price	(772)	
Freight/terminalling saving for not exporting	<u>95</u>	
Net styrene price paid	(677)	
Net styrene price paid /tonne GPPS produced <sup>3</sup> , ie purchase feedstock styrene	(663)	
Mineral oil	(20)	
Co-product sales /tonne of PS produced	-	
Variable cost PS unit <sup>4</sup>	<u>(19)</u>	
		(702)
<b>Standalone margin</b>		<b>109</b>

<sup>1</sup>The model assumes 3.278 tonnes of naphtha are required to produce 1 tonne of ethylene, 0.29 tonnes of ethylene and 0.79 tonnes of benzene are required to produce 1 tonne of styrene and 0.98 tonnes of styrene are required to produce 1 tonne of GPPS. The average net naphtha price (including freight costs) for 2009 was \$534/tonne (with an average \$:€ conversion rate of 1.40).

<sup>2</sup>Co-product sales include credits for propylene, butadiene, benzene, raffinate-1, pygas and a fuel export balance from the cracker and credits for toluene and fuel by-product from the styrene unit.

<sup>3</sup>The model assumes 0.29 tonnes of ethylene and 0.79 tonnes of benzene are required to produce 1 tonne of styrene and 0.98 tonnes of styrene are required to produce 1 tonne of GPPS.

<sup>4</sup>Includes power and catalysts/chemicals.

The calculation for HIPS is similar, but includes 8% polybutadiene as a feedstock.

## **DIFFERENCE BETWEEN NON-INTEGRATED AND INTEGRATED**

- Non-integrated or standalone: market participant involved with PS production only. The business model is to buy styrene (or, for HIPS, styrene and polybutadiene), convert it into PS and sell the PS. Our margin model assumption is that the plants are co-located and the styrene is transferred at FOB values. This business model is applicable to just under half the manufacturing facilities in Europe.
- Integrated: market participant involved with ethylene, benzene, styrene and PS (GPPS and/or HIPS) production. Buy naphtha feedstock, process it into ethylene, benzene and cracker co-products, convert the ethylene with the benzene into ethylbenzene and then dehydrate it into styrene monomer. The final process is polymerisation into PS and sell both the PS and cracker co-products. This business model is applicable to over half of the manufacturing facilities in Europe.

## **MODEL YIELD PATTERN AND CALCULATION**

- Plant manufacturing data relates to the variable cost components of the chemical unit operations. Yield pattern data relates to the overall material balance of the cracker unit, for example for 1 tonne of ethylene produced, a cracker requires 3.2 tonnes of naphtha feedstock, and will produce other co-products (including, but not limited to, propylene, butadiene and benzene) of 2.2 tonne in addition to the 1 tonne of ethylene. The plant manufacturing and feedstock yield model data for the cracker unit have been provided by Linde Engineering, a division of Linde AG.

The exact yield pattern used cannot be published in an unrestricted document such as this methodology statement. However, for ICIS Margin – Polystyrene Europe report subscribers with a specific requirement to see this data, it can be shared on a case-by-case basis.

Please contact the [Global ICIS Customer Support Centre](#) if this data is required.

## ASSESSMENT INPUTS

Margins are calculated on a weekly basis. The following pricing inputs are used to generate the full content of the ICIS Margin – Polystyrene Europe report:

- Polystyrene (GP) PS in Europe domestic FD EU (€/tonne)
- Polystyrene (GP) PS in Europe spot FD NWE (€/tonne) [to 25 January 2013]
- Polystyrene (HIPS) PS in Europe domestic FD EU (€/tonne)
- Polystyrene (HIPS) PS in Europe spot FD EU (€/tonne) [to 25 January 2013]
- Styrene in Europe contract average FD Barge NWE [from 1 July 2011; previously Styrene in Europe contract FD Barge NWE] (€/tonne)
- Styrene in Europe spot CIF RDAM (weekly average) (\$/tonne)
- Naphtha in Europe spot CIF NWE (Friday assessment) (\$/tonne)
- Gasoline: unleaded premium in Europe spot FOB barges ARA (\$/tonne)
- Fuel Oil 1% in Europe spot CIF cargoes NWE (weekly average) (\$/tonne)
- Ethylene in Europe monthly contract FD NWE [from January 2009, previously quarterly] (€/tonne)
- Ethylene in Europe spot CIF NWE (\$/tonne)
- Propylene in Europe monthly contract FD NWE [from January 2009, previously quarterly] (€/tonne)
- Propylene (polymer grade) in Europe spot CIF NWE (€/tonne)
- Butadiene in Europe monthly contract FD NWE [from January 2011, previously quarterly] (€/tonne)
- Butadiene in Europe spot FOB Rotterdam (\$/tonne)
- Polybutadiene Rubber low-cis grade in Asia Pacific spot CFR NE Asia [based on a European export formula] (\$/tonne)
- Polybutadiene Rubber high-cis grade in Asia Pacific spot CFR NE Asia [based on a European export formula] (\$/tonne)
- Benzene in Europe monthly contract FOB NWE [from January 2004, previously quarterly] (€/tonne)
- Benzene in Europe spot CIF ARA (\$/tonne)
- Paraffinic Base Oils in Europe Spot SN 150 FOB NWE (\$/tonne)

- Raffinate-1 in Europe spot CIF NWE (\$/tonne)
- Toluene in Europe monthly contract FOB NWE [from January 2004, previously quarterly] (€/tonne)
- Toluene in Europe spot FOB Rdam (weekly average) (\$/tonne) [to 25 January 2013]

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 above pricing inputs, ICIS pricing uses the \$/€ mid-market exchange rate on the date of the report publication issued at 16:00 London time by XE ([www.xe.com](http://www.xe.com)). Mid-market rates are derived from the mid-points between the buy and sell rates of large-value transactions in the global currency markets.

A key objective of the calculation procedure is to provide a weekly summary that is most strongly aligned to the reported market price positions on the date of publication.

Where ICIS price quotations are not available for individual weeks due to public holidays, then prior week data is carried forward for the specific purpose of populating the model and preventing model inconsistency. This form of data interpolation is inferring some limited data points that may not be market derived, and customers should be aware of this assumption.

All data in the ICIS Margin – Polystyrene Europe report is denominated in euros unless specifically indicated otherwise.

## **Longer Range Views:**

### **Domestic vs. Buy Spot Styrene, Sell Domestic PS – introduced from 1 February 2013**

This provides a weekly comparison of the calculated margin for domestic-based PS sales measured across the PS unit versus the margin achieved by selling PS at domestic price using purchased spot styrene feedstock.

Charts for GPPS and HIPS are published on alternate months.

### **Spot vs. Contract/Domestic Margin (Integrated) – discontinued from 25 January 2013**

This provides a weekly comparison of the calculated margin for spot-based PS sales minus contract/domestic-based sales. This switch of ICIS pricing reference is also considered for the naphtha cracker products, so the analysis is deeper than a simple comparison of spot versus contract PS price netbacks. When this differential provides a positive numerical output, this implies that spot-based PS sales derive a higher



margin for an integrated producer than contract/domestic-based sales. Similarly, when this differential provides a negative numerical output, this implies that spot-based PS sales derive a lower margin for an integrated producer than contract/domestic-based sales.

For the avoidance of any doubt, the basis on which ICIS pricing data is utilised for each of these respective models is summarised in the table below. For more detailed information about these quotations, please refer to the assessment inputs section above.

ICIS price	Spot Margin Model	Contract Margin Model
GPPS	Spot	Domestic
HIPS	Spot	Domestic
Styrene	Spot	Contract
Naphtha	Spot	Spot
Gasoline	Spot	Spot
Fuel Oil	Spot	Spot
Ethylene	Spot	Contract
Propylene	Spot	Contract
Butadiene	Spot	Contract
Benzene	Spot	Contract
Mineral Oil	Spot	Spot
Raffinate-1	Spot	Spot
Paraffinic Base Oil (Mineral oil proxy)	Spot	Spot
Toluene	Spot	Contract
Polybutadiene	Spot	Spot

\*Spot model discontinued from 25 January 2013

### **Spot vs. Domestic Margin (standalone) – discontinued from 25 January 2013**

This provides a weekly comparison of the calculated margin for spot-based PS sales minus domestic-based sales measured across the PS unit. When this differential provides a positive numerical output, this implies that spot-based PS sales derive a higher margin than domestic-based sales. Similarly, when this differential provides a negative numerical output, this implies that spot-based PS sales derive a lower margin than domestic-based sales.



## READING THE CHARTS

In the short-term charts and longer range margin view, the integrated margin is derived by reading the top of the wedge, the sum of the styrene margin per tonne of PS (yellow) and the standalone PS margin (blue). Where the standalone margin is a loss (red), the integrated margin is read as the top of the yellow wedge or, where there is no yellow wedge, the bottom of the red.

## PUBLISHING FREQUENCY – MONTHLY\*

The ICIS Margin - Polystyrene Europe report is produced on a Monday using data from the last Friday close of business in Europe and distributed to customers on the following Tuesday, subject to schedule planning. The day of publication may be subject to revision particularly around public holidays.

\*Published monthly from June 2014; previously weekly. Margins continue to be calculated on a weekly basis.

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