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ARGUS PETROCHEMICAL PRODUCTION ECONOMICS

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The most up-to-date Argus Petrochemical Production Economics Methodology
is available on www.argusmedia.com

Petrochemical production economics

Argus publishes information about the economics of generalised petrochemical production units based on Argus' feedstock and petrochemical price assessments and a set of underlying assumptions outlined in this methodology.

Argus petrochemical production economics are not intended to represent the economics of any particular production unit and are based around a central model, adjusted for regional characteristics.

Argus petrochemical production economics are published via the Argus Direct online platform and are available through various Argus data feeds. Subsets of this data may be included in one or more Argus publications.

A publication schedule is available at www.argusmedia.com

Ethylene steam-cracker margins

Ethylene cash margins measure the profitability of producing ethylene from a variety of feedstocks in different regions, based on a central model.

The central model

Argus uses the same consumption factors and product yields for all regions to allow for an effective comparison across feedstocks and locations. The central model is designed to be regionally generic and not representative of a single technology.

The model calculates the cash cost of production in ethylene terms, less the value of co-products and returns a cash margin.

Assumptions included in the model are under continuous review and may be changed at any time.

Published margins

Argus publishes the following cracker margins for the US:

- US daily ethylene gross spot cash margin ethane \$/t
- US daily ethylene gross spot cash margin ethane-propane mix \$/t

A monthly average of each daily cracker margin is also published.

Argus publishes the following cracker margins for Europe:

- Naphtha net monthly contract (\$/t and €/t)

Model parameters

All in USD/t ethylene unless stated.

Ethylene: the Argus assessment of the ethylene price per tonne, less a representative discount rate where described below and for net margin calculations only.

Ethylene logistics cost: an Argus assessment of the cost of ethylene logistics, includes an inflation adjustment

Capacity: assumed to be 700,000 t/yr in the US and 500,000 t/yr in Europe

Capex costs: the sum of the following components

- **ISBL (USD mn):** inside battery line costs — assessed per million tonnes of capacity in the US and adjusted to other regions and for the assumed capacity of the plant, includes an inflation adjustment
- **OSBL (USD mn):** outside battery line costs — assessed per million tonnes of capacity in the US and adjusted to other regions and for the assumed capacity of the plant, includes an inflation adjustment
- **Other project costs (USD mn):** assumed to be 25pc of the ISBL and OSBL, includes an inflation adjustment

Feedstock costs: the sum of the following components

- **Feedstocks variable costs:** the Argus assessments for feedstocks (as outlined below) * the number of tonnes of that feedstock required to produce 1t of ethylene in the Argus model
- **Catalysts and chemicals:** the costs of chemicals and catalysts required to produce 1t of ethylene in the Argus model
- **Feedstocks logistics:** logistics costs for feedstocks required to produce 1t of ethylene in the Argus model * the amount of feedstock required to produce 1t of ethylene in the Argus model, includes an inflation adjustment

Co-products: the sum of the following components

- **Propylene:** the Argus assessment of the propylene price (as outlined below) * the number of tonnes of propylene produced as a result of producing 1t of ethylene in the Argus model, less a representative discount rate for net margin calculations only
- **Butadiene:** the Argus assessment of the butadiene price (as outlined below) * the number of tonnes of butadiene produced as a result of producing 1t of ethylene in the Argus model less a representative discount rate for net margin calculations only
- **Raffinate-1:** the Argus calculation of the raffinate-1 price (as outlined below) * the number of tonnes of raffinate-1 produced as a result of producing 1t of ethylene in the Argus model
- **Pygas:** the Argus calculation of the pygas price (as outlined below)
- **Fuel credit:** the Argus assessment of the fuel price (as outlined below) * the amount of fuel produced as a result of producing 1t ethylene in the Argus model
- **Co-product logistics:** for each co-product a logistic cost per tonne is assumed for the Argus model and is multiplied by the amount of co-product produced as the result of producing 1t of ethylene — this figure is the sum of that outright dollar

value for each of the co-products described above, includes an inflation adjustment

Utilities: the sum of the following components

- **Power:** Argus power price assessments (as outlined below) * the amount of electricity required to produce 1t of ethylene in the Argus model
- **Fuel:** the Argus assessment of the fuel price (as outlined below) * the number of tonnes of fuel oil required to produce 1t of ethylene in the Argus model
- **Other:** The Argus assessment of the fuel price (as outlined below) * a constant

Fixed costs: the sum of the following components

- **Labourer salary:** the cost of employing an assumed number of labourers at an assessed annual salary divided by the ethylene capacity of the facility
- **Foreperson salary:** the cost of employing an assumed number of forepersons at an assessed annual salary divided by the ethylene capacity of the facility
- **Supervisor salary:** the cost of employing an assumed number of supervisors at an assessed annual salary divided by the ethylene capacity of the facility
- **Maintenance:** a percentage based on the Argus model of the ISBL costs described above divided by the ethylene capacity of the facility
- **Overheads:** a percentage based on the Argus model of the labour and maintenance costs described above
- **Insurance and tax:** a percentage based on the Argus model of the capex costs described above divided by the ethylene capacity of the facility

Total cash cost: the sum of the variable costs and fixed costs described above

Cash margin: the Argus ethylene price per tonne (outlined below) minus ethylene logistics costs and minus the total cash cost

Currency conversion

Where required, Argus converts the currency of model inputs at the time each input is created, and before that input has been included in the model. For example, a daily electricity price will be converted using a daily exchange rate before being included in the model, and a monthly price will be converted using a month-average exchange rate.

Timing

Margins are calculated using the latest available Argus price assessments for feedstocks and product prices.

Monthly averages of daily spot cracker margins are also published for the named month on the first working day of the next month. For example, the January average cracker margin will be published on the first publication date in February.

Monthly contract margins will be published for the named month on the first working day of the next month. For example, the January

average cracker margin will be published on the first publication date in February.

Corrections to assessments

Argus will on occasion publish corrections to price assessments after the publication date. We will correct errors that arise from clerical mistakes, calculation errors, or a misapplication of our stated methodology. Argus will not retroactively assess markets based on new information learned after the assessments are published. We make our best effort to assess markets based on the information we gather during the trading day assessed.

If an Argus price assessment or other input to the model is corrected, the model will be re-run and corrected values distributed to subscribers.

Ethics and compliance

Argus operates according to the best practices in the publishing field, and maintains thorough compliance procedures throughout the firm. We want to be seen as a preferred provider by our subscribers, who are held to equally high standards, while at the same time maintaining our editorial integrity and independence. Argus has a strict ethics policy that applies to all staff. The policy can be found on our website at www.argusmedia.com. Included in this policy are restrictions against staff trading in any energy commodity or energy related stocks, and guidelines for accepting gifts. Argus also has strict policies regarding central archiving of email and instant messenger communication, maintenance and archiving of notes, and archiving of spreadsheets and deal lists used in the price assessment process. Argus publishes prices that report and reflect prevailing levels for open-market arms length transactions (please see the [Argus Global Compliance Policy](#) for a detailed definition of arms length).

Review of methodology

The overriding objective of any methodology is to produce price assessments which are reliable and representative indicators of commodity market values and are free from distortion. As a result, Argus editors and reporters are regularly examining our methodologies and are in regular dialogue with the industry in order to ensure that the methodologies are representative of the market being assessed. This process is integral with reporting on a given market. In addition to this ongoing review of methodology, Argus conducts reviews of all of its methodologies and methodology documents on at least an annual basis.

Argus market report editors and management will periodically and as merited initiate reviews of market coverage based on a qualitative analysis that includes measurements of liquidity, visibility of market data, consistency of market data, quality of market data and industry usage of the assessments. Report editors will review:

- Appropriateness of the methodology of existing assessments
- Termination of existing assessments
- Initiation of new assessments.

The report editor will initiate an informal process to examine viability. This process includes:

- Informal discussions with market participants
- Informal discussions with other stakeholders
- Internal review of market data

Should changes, terminations, or initiations be merited, the report editor will submit an internal proposal to management for review and approval. Should changes or terminations of existing assessments be approved, then formal procedures for external consultation are begun.

Changes to methodology

Formal proposals to change methodologies typically emerge out of the ongoing process of internal and external review of the methodologies. Formal procedures for external consultation regarding material changes to existing methodologies will be initiated with an announcement of the proposed change published in the relevant Argus report. This announcement will include:

- Details on the proposed change and the rationale
- Method for submitting comments with a deadline for submissions
- For prices used in derivatives, notice that all formal comments will be published after the given consultation period unless submitter requests confidentiality.

Argus will provide sufficient opportunity for stakeholders to analyse and comment on changes, but will not allow the time needed to follow these procedures to create a situation wherein unrepresentative or false prices are published, markets are disrupted, or market participants are put at unnecessary risk. Argus will engage with industry throughout this process in order to gain acceptance of proposed changes to methodology. Argus cannot however guarantee universal acceptance and will act for the good order of the market and ensure the continued integrity of its price assessments as an overriding objective.

Following the consultation period, Argus management will commence an internal review and decide on the methodology change. This will be followed by an announcement of the decision, which will be published in the relevant Argus report and include a date for implementation. For prices used in derivatives, publication of stakeholders' formal comments that are not subject to confidentiality and Argus' response to those comments will also take place.

Regional and feedstock specific inputs to the central model
Europe
Ethylene

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|----------|-----------------------------------|--|
| Ethylene | Ethylene del NWE contract month 1 | See the Argus Ethylene methodology |
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Feedstock variable costs

| | | |
|---------|-------------------------|---|
| Naphtha | Naphtha 65 para NWE cif | See the Argus European Products methodology |
|---------|-------------------------|---|

Co-products

| | | |
|-----------|---|---|
| Propylene | Propylene polymer grade del Europe contract (MCP) | See the Argus Propylene methodology |
|-----------|---|---|

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|-----------|--|---|
| Butadiene | Butadiene delivered NWE contract month | See the Argus Butadiene methodology |
|-----------|--|---|

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|-------------|---|---|
| Raffinate-1 | Calculated based on the Argus assessment of naphtha 65 para NWE cif | See the Argus European Products methodology |
|-------------|---|---|

| | | |
|-------|--|---|
| Pygas | Calculated based on the Argus assessment of naphtha 65 para NWE cif and Benzene cif NWE contract less an extraction cost | See the Argus European Products methodology and the Argus Benzene and Derivatives methodology |
|-------|--|---|

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|-------------|-----------------------------|---|
| Fuel credit | Fuel oil 1% NWE fob cargoes | See the Argus European Products methodology |
|-------------|-----------------------------|---|

Utilities

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|-------|-------------------------------|--|
| Power | Dutch OTC base load day ahead | See the Argus European Electricity methodology |
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| Fuel | fuel oil 1% NWE fob cargoes | See the Argus European Products methodology |
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|-------|-----------------------------|---|
| Other | fuel oil 1% NWE fob cargoes | See the Argus European Products methodology |
|-------|-----------------------------|---|

US
Ethylene

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|----------|--|--|
| Ethylene | Ethylene pipeline Mont Belvieu month 1 | See the Argus Ethylene methodology |
|----------|--|--|

Feedstock variable costs

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|--------|----------------------------------|--|
| Ethane | Ethane Mt Belvieu Enterprise wet | See the Argus NGL Americas methodology |
|--------|----------------------------------|--|

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| Ethane-propane mix | A 80/20pc weighting of Ethane/propane mix Mt Belvieu Enterprise wet and propane Mt Belvieu Enterprise wet | See the Argus NGL Americas methodology |
|--------------------|---|--|

Co-products

| | | |
|-----------|---|--|
| Propylene | US Gulf coast polymer-grade propylene (PGP) | See the Argus NGL Americas methodology |
|-----------|---|--|

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|-----------|------------------|---|
| Butadiene | Butadiene fob US | See the Argus Butadiene methodology |
|-----------|------------------|---|

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|-------------|--|--|
| Raffinate-1 | Naphtha full-range USGC waterborne del | See the Argus NGL Americas methodology |
|-------------|--|--|

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|-------|---|---|
| Pygas | Gasoline 87 conv USGC waterborne fob lowest RVP and Benzene US Gulf coast less an extraction cost | See the Argus US Products methodology |
|-------|---|---|

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|-------------|---------------------------|---|
| Fuel credit | Fuel oil No 6 3% USGC fob | See the Argus US Products methodology |
|-------------|---------------------------|---|

Utilities

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|-------|--|--|
| Power | The average of Power ERCOT Houston Off-peak day-ahead and Power ERCOT Houston Peak day-ahead | See the Argus US Electricity methodology |
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|------|-------------------------------------|--|
| Fuel | Natural gas hub Henry Hub day-ahead | See the Argus Natural Gas Americas methodology |
|------|-------------------------------------|--|

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| Other | Natural gas hub Henry Hub day-ahead | See the Argus Natural Gas Americas methodology |
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