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ARGUS BIOMASS MARKETS

Contents:

Methodology overview	2
The market	5
Argus cif northwest Europe spot index	6
Baltic and Portugal indexes	6
Asia-Pacific indexes	7
North America netback prices	8
Forward price assessments	8
Premium pellets	8
Wood chips	9
Monthly averages	9
Break-even electricity prices	9
Shipping costs	9
European industrial biomass specifications	10
Asia biomass specifications	10

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The most up-to-date Argus Biomass Markets methodology is available on www.argusmedia.com

Methodology overview

Methodology rationale

Argus strives to construct methodologies that reflect the way the market trades. Argus aims to produce price assessments which are reliable and representative indicators of commodity market values and are free from distortion. As a result, the specific currencies, volume units, locations and other particulars of an assessment are determined by industry conventions.

In the biomass markets, Argus publishes physical market prices in the open market as laid out in the specifications and methodology guide. Argus uses the trading period deemed by Argus to be most appropriate, in consultation with industry, to capture market liquidity.

In order to be included in the assessment process, deals must meet the minimum volume, delivery, timing and specification requirements in our methodology. In illiquid markets, and in other cases where deemed appropriate, Argus assesses the range within which product could have traded by applying a strict process outlined later in this methodology.

Survey process

Argus price assessments are informed by information received from a wide cross section of market participants, including producers, consumers and intermediaries. Argus reporters engage with the industry by proactively polling participants for market data. Argus will contact and accept market data from all credible market sources including front and back office of market participants and brokers. Argus will also receive market data from electronic trading platforms, the Argus Open Markets® platform (AOM®) and directly from the back offices of market participants. Argus will accept market data by telephone, instant messenger, email, AOM or other means.

Argus encourages all sources of market data to submit all market data to which they are a party that falls within the Argus stated methodological criteria for the relevant assessment. Argus encourages all sources of market data to submit transaction data from back office functions.

Throughout all markets, Argus is constantly seeking to increase the number of companies willing to provide market data. Reporters are mentored and held accountable for expanding their pool of contacts. The number of entities providing market data can vary significantly from day to day based on market conditions.

For certain price assessments identified by local management, if more than 50pc of the market data involved in arriving at a price assessment is sourced from a single party the supervising editor will engage in an analysis of the market data with the primary reporter to ensure that the quality and integrity of the assessment has not been affected.

Market data usage

In each market, Argus uses the methodological approach deemed to be the most reliable and representative for that market. Argus will utilise various types of market data in its methodologies, to include:

- Transactions
- Bids and offers
- Other market information, to include spread values between grades, locations, timings, and many other data.

In many markets, the relevant methodology will assign a relatively higher importance to transactions over bids and offers, and a relatively higher importance to bids and offers over other market information. Certain markets however will exist for which such a hierarchy would produce unreliable and non-representative price assessments, and so the methodology must assign a different relative importance in order to ensure the quality and integrity of the price assessment. And even in markets for which the hierarchy normally applies, certain market situations will at times emerge for which the strict hierarchy would produce non-representative prices, requiring Argus to adapt in order to publish representative prices.

Verification of transaction data

Reporters carefully analyse all data submitted to the price assessment process. These data include transactions, bids, offers, volumes, counterparties, specifications and any other information that contributes materially to the determination of price. This high level of care described applies regardless of the methodology employed. Specific to transactions, bids, and offers, reporters seek to verify the price, the volume, the specifications, location basis, and counterparty. In some transactional average methodologies, reporters also examine the full array of transactions to match counterparties and arrive at a list of unique transactions. In some transactional average methodologies, full details of the transactions verified are published electronically and are accessible by subscribers. In those methodologies, the deals are also published in the daily report.

Several tests are applied by reporters in all markets to transactional data to determine if it should be subjected to further scrutiny. If a transaction has been identified as failing such a test, it will receive further scrutiny. For assessments used to settle derivatives and for many other assessments, Argus has established internal procedures that involve escalation of inquiry within the source's company and escalating review within Argus management. Should this process determine that a transaction should be excluded from the price assessment process, the supervising editor will initiate approval and, if necessary, documentation procedures.

Primary tests applied by reporters

- Transactions not transacted at arm's length, including deals between related parties or affiliates.
- Transaction prices that deviate significantly from the mean of all transactions submitted for that day.
- Transaction prices that fall outside of the generally observed lows and highs that operated throughout the trading day.
- Transactions that are suspected to be a leg of another transaction or in some way contingent on an unknown transaction.
- Single deal volumes that significantly exceed the typical transaction volume for that market.
- Transaction details that are identified by other market participants as being for any reason potentially anomalous and perceived by Argus to be as such.

- Transaction details that are reported by one counterparty differently than the other counterparty.
- Any transaction details that appear to the reporter to be illogical or to stray from the norms of trading behaviour. This could include but is not limited to divergent specifications, unusual delivery location and counterparties not typically seen.
- Transactions that involve the same counterparties, the same price and delivery dates are checked to see that they are separate deals and not one deal duplicated in Argus records.

Secondary tests applied by editors for transactions identified for further scrutiny

Transaction tests

- The impact of linkage of the deal to possible other transactions such as contingent legs, exchanges, options, swaps, or other derivative instruments. This will include a review of transactions in markets that the reporter may not be covering.
- The nature of disagreement between counterparties on transactional details.
- The possibility that a deal is directly linked to an offsetting transaction that is not publicly known, for example a “wash trade” which has the purpose of influencing the published price.
- The impact of non-market factors on price or volume, including distressed delivery, credit issues, scheduling issues, demurrage, or containment.

Source tests

- The credibility of the explanation provided for the outlying nature of the transaction.
- The track record of the source. Sources will be deemed more credible if they
 - Regularly provide transaction data with few errors.
 - Provide data by Argus’ established deadline.
 - Quickly respond to queries from Argus reporters.
 - Have staff designated to respond to such queries.
- How close the information receipt is to the deadline for information, and the impact of that proximity on the validation process.

Assessment guidelines

When insufficient, inadequate, or no transaction information exists, or when Argus concludes that a transaction based methodology will not produce representative prices, Argus reporters will make an assessment of market value by applying intelligent judgment based on a broad array of factual market information. Reporters must use a high degree of care in gathering and validating all market data used in determining price assessments, a degree of care equal to that applying to gathering and validating transactions. The information used to form an assessment could include deals done, bids, offers, tenders, spread trades, exchange trades, fundamental supply and demand information and other inputs.

The assessment process employing judgment is rigorous, replicable, and uses widely accepted valuation metrics. These valuation metrics mirror the process used by physical commodity traders

to internally assess value prior to entering the market with a bid or offer. Applying these valuation metrics along with sound judgment significantly narrows the band within which a commodity can be assessed, and greatly increases the accuracy and consistency of the price series. The application of judgment is conducted jointly with the supervising editor, in order to be sure that guidelines below are being followed. Valuation metrics include the following:

Relative value transactions

Frequently transactions occur which instead of being an outright purchase or sale of a single commodity, are instead exchanges of commodities. Such transactions allow reporters to value less liquid markets against more liquid ones and establish a strong basis for the exercise of judgment.

- Exchange one commodity for a different commodity in the same market at a negotiated value.
- Exchange delivery dates for the same commodity at a negotiated value.
- Exchange a commodity in one location for the same commodity at another location at a negotiated value.

Bids and offers

If a sufficient number of bids and offers populate the market, then in most cases the highest bid and the lowest offer can be assumed to define the boundaries between which a deal could be transacted.

Comparative metrics

The relative values between compared commodities are readily discussed in the market and can be discovered through dialogue with market participants. These discussions are the precursor to negotiation and conclusion of transactions.

- Comparison to the same commodity in another market centre.
- Comparison to a more actively traded but slightly different specification commodity in the same market centre.
- Comparison to the same commodity traded for a different delivery timing
- Comparison to the commodity’s primary feedstock or primary derived product(s).
- Comparison to trade in the same commodity but in a different modality (as in barge versus oceangoing vessel) or in a different total volume (as in full cargo load versus partial cargo load).

Volume minimums and transaction data thresholds

Argus typically does not establish thresholds strictly on the basis of a count of transactions, as this could lead to unreliable and non-representative assessments and because of the varying transportation infrastructure found in all commodity markets. Instead, minimum volumes are typically established which may apply to each transaction accepted, to the aggregate of transactions, to transactions which set a low or high assessment or to other volumetrically relevant parameters.

For price assessments used to settle derivatives, Argus will seek to establish minimum transaction data thresholds and when no such

threshold can be established Argus will explain the reasons. These thresholds will often reflect the minimum volumes necessary to produce a transaction-based methodology, but may also establish minimum deal parameters for use by a methodology that is based primarily on judgment.

Should no transaction threshold exist, or should submitted data fall below this methodology's stated transaction data threshold for any reason, Argus will follow the procedures outlined elsewhere in this document regarding the exercise of judgment in the price assessment process.

Transparency

Argus values transparency in energy markets. As a result, where available, we publish lists of deals in our reports that include price, basis, counterparty and volume information. The deal tables allow subscribers to cross check and verify the deals against the prices. Argus feels transparency and openness is vital to developing confidence in the price assessment process.

Swaps and forwards markets

Argus publishes forward assessments for numerous markets. These include forward market contracts that can allow physical delivery and swaps contracts that swap a fixed price for the average of a floating published price. Argus looks at forward swaps to inform physical assessments but places primary emphasis on the physical markets.

Publications and price data

Argus biomass prices are published in the *Argus Biomass Markets* report. The price data are available independent of the text-based report in electronic files that can feed into various databases. These price data are also supplied through various third-party data integrators. The Argus website also provides access to prices, reports and news with various web-based tools. All Argus prices are kept in a historical database and available for purchase. Contact your local Argus office for information.

A publication schedule is available at www.argusmedia.com

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.

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).

Consistency in the assessment process

Argus recognises the need to have judgment consistently applied by reporters covering separate markets, and by reporters replacing existing reporters in the assessment process. In order to ensure this consistency, Argus has developed a programme of training and oversight of reporters. This programme includes:

- A global price reporting manual describing among other things the guidelines for the exercise of judgment.
- Cross-training of staff between markets to ensure proper holiday and sick leave backup. Editors that float between markets to monitor staff application of best practices.
- Experienced editors overseeing reporting teams are involved in daily mentoring and assisting in the application of judgment for illiquid markets.
- Editors are required to sign-off on all price assessments each day, thus ensuring the consistent application of judgment.

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.

The market

Argus Biomass Markets is a weekly report that publishes prices, market commentary and shipping costs on the international bulk spot market for industrial grade wood pellets, wood chips and palm kernel shells. The report also contains prices and market commentary for the premium wood pellet market.

The report is published on Wednesday or on the nearest working day in the UK, with the exception of the week between 25 December and 1 January.

The Argus methodology relies on informed analysis of market data, including deals, bids and offers, and the results of a weekly survey of active market participants. The market survey involves participants in each market segment. The approach is methodical and

standardised and market information is tested against the views of market participants.

Deals, bids and offers must be considered repeatable to be reflected in the weekly assessments.

Transactions done for dates outside of Argus loading or delivery periods, market survey responses that apply to dates outside of those periods, and price information for specifications not directly included in the methodology are considered when assessing prices if Argus believes they have affected, or are relevant to, market value for the standardised products reported in *Argus Biomass Markets*.

Argus asks for consistency from sources and aims to contact the same source within each firm each week to avoid inconsistencies.

Information is, as far as possible, verified, and is archived in databases.

Export prices are on a free-on-board (fob) basis from the port of loading. Delivered prices are on a cost-insurance-freight (cif) basis to the port of discharge for industrial pellet assessments and on a delivered basis for premium pellet assessments.

Assessment timing

Weekly price assessments for markets in Europe and the Americas, cover the week to 4pm London time on the day of publication. Weekly price assessments for Asia-Pacific markets cover the week to 5.30pm Singapore time on the day of publication.

Information that applies to this period can be accepted until the time of publication.

Loading and delivery timing

Spot industrial wood pellet, wood chip and palm kernel shell price assessments in *Argus Biomass Markets* cover loading or delivery within 90 days from the date of assessment. *Argus Biomass Markets* also contains assessments of forward prices for delivery for four quarters ahead, and for three years ahead. Forward prices are published for the cif northwest Europe, fob Baltic, fob Portugal, fob southeast US, fob southwest Canada and fob northeast US wood pellet markets and for the cif northwest Europe wood chip market.

The prompt quarter rolls on the first day of the second month of the quarter. For example, the third quarter becomes the prompt quarter on 1 May and the fourth quarter becomes the prompt quarter on 1 August. The prompt year rolls on the first working day of the year. For example, 2015 became the prompt year on 1 January 2014.

Premium wood pellet prices are assessed for delivery within 45 days from the date of assessment.

Argus cif northwest Europe spot index

Argus assesses the price of 25,000t spot cif northwest Europe deliveries of industrial wood pellets, where “spot” is defined as delivery within 90 days. Trades for smaller or larger quantities may be included in the assessment process. Northwest Europe is defined as ports within a 750km radius of Rotterdam.

The Argus cif northwest Europe spot index is comprised of a volume-weighted average of deals done for delivery within a rolling 90-day period, the best firm bid and offer available for delivery during that period, and a survey of market participants' views of the price for delivery during the same.

If 50,000t or more of total index-relevant trade takes place in a given week, regardless of the number of transactions or the size of any individual transaction, a volume-weighted average of deals done will form 50pc of the weekly value, with the result of the market survey forming the remaining 50pc.

If less than 50,000t of index-relevant trade takes place in a given week, a volume-weighted average of deals done will make up a corresponding share of the index. Each 100t of trade will make up 0.1pc of the index, so each 1,000t of aggregate trade during a week will make up one percentage point of the final weekly index.

The average of the best bid and the best offer will be used for the remainder of the 50pc of the index that would otherwise be a volume-weighted average of trades. Bids and offers must be firm and attributable.

If no deals are done, but a best bid and best offer are available, then this best bid/offer average will make up 50pc of the index. If a best bid is available but a best offer is not, or if a best offer is available but a bid is not, then that lone bid or offer will not be used in the calculation of the index.

Because of the relative illiquidity of the market, there is no set minimum volume for individual trades. If less than 50,000t of total index-relevant trade takes place during the week and a best bid and offer is not available, the market survey element of the index will increase in direct inverse proportion to the volume of trade reported. If there

are no deals and no firm bid and offer, the index will be calculated entirely from the market survey.

If a deal is done on a fob basis but is coupled with the freight into northwest Europe, the total delivered price into northwest Europe will be included in the index.

If price information is received about the cif northwest Europe or North American markets in a currency other than US dollars, or about the Baltic or Portugal markets in a currency other than euros, Argus will use the exchange rate at the day of publication to convert those prices into the market's standard currency.

Argus will take into account the sustainability status of a cargo when deciding whether to include it in the index, based on current market practice.

Market survey transparency

Argus solicits market survey responses for the individual months contained within the 90-day spot assessment period and displays an average survey result value for each month contained in the 90-day period. Argus also accepts market survey responses for the 90-day spot period as a whole, but closely scrutinises the valuations for the 90-day period against the weighted average of the monthly valuations to ensure consistency and accuracy and to prevent bias towards one part of the 90-day period or another.

The average of market survey responses for each month of the 90-day spot period is published on page two of *Argus Biomass Markets* to better illustrate the composition of the market-survey component of the spot cif northwest Europe index.

Currency and unit of measure

Prices are assessed and published in \$/t and converted to \$/MWh.

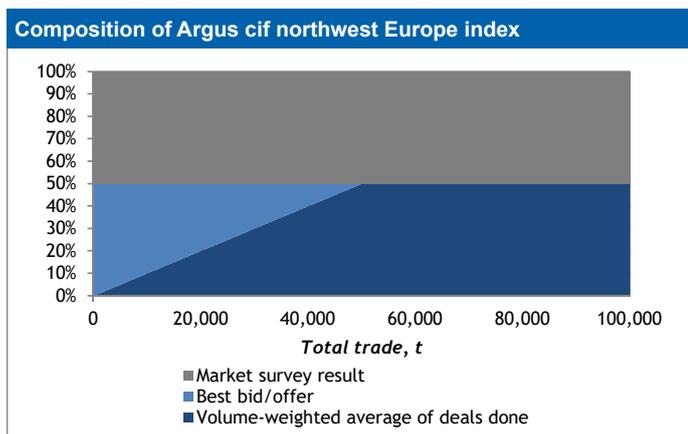
Baltic and Portugal indexes

Argus assesses the price of 3,000-8,000t fob Baltic and fob Portugal wood pellet shipments.

Owing to lower liquidity in the fob Baltic and fob Portugal markets, Argus seeks only a single price for the 90-day period of the spot indexes. Due to lower average cargo sizes, Argus does not apply a mechanical scale to adjust the weight given to transactions in the final index. The spot indexes for the Baltic and Portugal markets are comprised of a volume-weighted average of index-relevant deals, which makes up 50pc of the index, and the market survey, which makes up the remaining 50pc of the index. If there are no index-relevant deals, the index will be calculated 100pc from the market survey. Any received trade data is tested against other market data.

Where possible and appropriate, Argus nets Baltic and Portuguese delivered spot trades back to the fob location and includes that fob price in its index or assessment.

Prices are assessed and published in €/t and converted to €/MWh.



Asia-Pacific indexes

Wood pellets

fob Vietnam to South Korea

The price of product meeting the minimum sustainability certification criteria imposed by authorities in South Korea, whether or not that product is eventually delivered to South Korea.

Third-party sustainability certification which includes certification for at least one part of the supply chain — for example, forest management — or on the chain of custody can be requested at the buyers' option.

Prices are for at least 3,000t of product loaded within 90 days of trade on a bulk or container basis.

The price is assessed based on trade, bids, offers and other market information. Reported trade informs the assessment, but does not mechanically define it. The assessment is published as a single point.

Specifications are as outlined in the table below. Prices are assessed and published in \$/t.

While a trade meeting the fob Vietnam to Japan FIT specification may also satisfy the requirement of the fob Vietnam to South Korea assessment, Argus may choose not to include the information in the assessment unless it is deemed material to the determination of the fob Vietnam to South Korea price.

fob Vietnam to Japan FIT

The price of product meeting certification criteria of generators operating under Japan's feed-in-tariff (FIT) or feed-in-premium (FIP) state support mechanisms, whether or not that product is eventually delivered to Japan.

Prices are for at least 10,000t of product loaded within 90 days of trade on a bulk basis.

The price is assessed based on trade, bids, offers and other market information. Reported trade informs the assessment, but does not mechanically define it. The assessment is published as a single point.

Specifications are as outlined in the table below. Prices are assessed and published in \$/t.

cfr Gwangyang spot index (container)

Argus assesses a cfr Gwangyang wood pellet spot price for delivery within 90 days. Delivery is on a container basis with a 3,000t minimum volume.

One 20 foot container is considered to carry 18.5t of wood pellets.

The cfr Gwangyang spot index is comprised of a volume-weighted average of index-relevant deals, which makes up 50pc of the index, and the market survey, which makes up the remaining 50pc of the index. If there are no index-relevant deals, the index will be calculated 100pc from the market survey.

If a deal is done on a fob basis but is coupled with the freight into the port of Gwangyang, the total delivered price into Gwangyang will be included in the index.

Specifications

The cfr Gwangyang spot index is of the price of wood pellets manufactured from wood fibre exclusively, without any type of binder or other chemically treated biomass. The wood pellets meet the quality specification of South Korean generators.

Prices are assessed and published in \$/t.

Palm kernel shell (PKS)

fob east coast Sumatra to Japan FIT

The price of product meeting certification requirements for generators operating under Japan's feed-in-tariff (FIT) or feed-in-premium (FIP) state support mechanisms, whether or not the product is eventually delivered to Japan.

Argus assesses a fob east coast Sumatra to Japan FIT PKS spot price, for delivery within the next 90 days. Delivery can be on bulk, handysize or container vessels, with a minimum volume of 8,000t.

The fob east coast Sumatra to Japan FIT PKS spot index is comprised of a volume-weighted average of index-relevant deals, which makes up 50pc of the index and the market survey, which makes up the remaining 50pc of the index. If there are no index-relevant deals, the index will be calculated 100pc from market survey. Where possible and appropriate, Argus nets the price of deals for Indonesian biomass on a delivered basis back to the fob east coast Sumatra price.

The Argus PKS fob east coast Sumatra to Japan FIT assessment is the price of PKS on board a vessel ready to sail, with all local taxes having been paid. The fob price includes the local export tax in place at the time of the trade.

Prices are assessed and published in \$/t.

fob east coast Sumatra excl. to Japan FIT

The price of product that does not meet certification requirements for generators operating under Japan's feed-in-tariff (FIT) or feed-in-premium (FIP) state support mechanisms, whether or not the product is eventually delivered to Japan.

Argus assesses a fob east coast Sumatra excl. to Japan FIT PKS spot price, for delivery within the next 90 days. Delivery can be on bulk, handysize or container vessels, with a minimum volume of 8,000t.

The fob east coast Sumatra excl. to Japan PKS spot index is comprised of a volume-weighted average of index-relevant deals, which makes up 50pc of the index and the market survey, which makes up the remaining 50pc of the index. If there are no index-relevant deals, the index will be calculated 100pc from market survey. Where possible and appropriate, Argus nets the price of deals for Indonesian biomass on a delivered basis back to the fob east coast Sumatra price.

The Argus PKS fob east coast Sumatra excl. to Japan PKS assessment is the price of PKS on board a vessel ready to sail, with all local taxes having been paid. The fob price includes the local export tax in place at the time of the trade.

Prices are assessed and published in \$/t.

fob peninsular Malaysia to Japan FIT

The price of product meeting certification requirements for generators operating under Japan's feed-in-tariff (FIT) or feed-in-premium (FIP) state support mechanisms, whether or not the product is eventually delivered to Japan.

Argus assesses a fob peninsular Malaysia to Japan FIT PKS spot price, for delivery within the next 90 days. Delivery can be on bulk, handysize or container vessels, with a minimum volume of 8,000t.

The fob peninsular Malaysia to Japan FIT PKS spot price is assessed based on trade, bids, offers and other market information. Reported trade informs the assessment, but does not mechanically define it. The assessment is published as a single point.

The Argus PKS fob peninsular Malaysia to Japan FIT assessment is the price of PKS on board a vessel ready to sail, with all local taxes having been paid. The fob price includes the local export tax in place at the time of the trade.

Prices are assessed and published in \$/t.

fob peninsular Malaysia excl. to Japan FIT

The price of product that does not meet certification requirements for generators operating under Japan's feed-in-tariff (FIT) or feed-in-premium (FIP) state support mechanisms, whether or not the product is eventually delivered to Japan.

Argus assesses a fob peninsular Malaysia excl. to Japan FIT PKS spot price, for delivery within the next 90 days. Delivery can be on bulk, handysize or container vessels, with a minimum volume of 8,000t.

The fob peninsular Malaysia excl. to Japan FIT PKS spot price is assessed based on trade, bids, offers and other market information. Reported trade informs the assessment, but does not mechanically define it. The assessment is published as a single point.

The Argus PKS fob peninsular Malaysia excl. to Japan FIT assessment is the price of PKS on board a vessel ready to sail, with all local taxes having been paid. The fob price includes the local export tax in place at the time of the trade.

Prices are assessed and published in \$/t.

North America netback prices

Argus assesses North American export prices as a netback to the cif northwest Europe spot index, using the freight rates specified below.

- **fob northeast US:** Savannah-ARA 25,000t + \$1/t
- **fob southeast US:** Savannah-ARA 25,000t
- **fob southwest Canada:** Vancouver-ARA

Prices are published in \$/t.

Forward price assessments

For the forward curve, Argus uses transactions, market survey results and various types of other market information, including spread values between grades, locations, timings many other data to inform its assessments.

Forward prices are assessed for four forward quarters and three forward calendar years for

Wood pellets

- cif northwest Europe (\$/t)
- fob Baltic (€/t)
- fob Portugal (€/t)
- fob southeast US (as a netback to cif northwest Europe, \$/t)
- fob southwest Canada (as a netback to cif northwest Europe, \$/t)
- fob northeast US (as a netback to cif northwest Europe, \$/t)

Wood chips

- cif NWE (€/GJ)

Forward prices are published as bid/offer pairs with the exception of the fob northeast US wood pellet prices, which are published as midpoint prices only.

Premium pellets

Argus assess premium wood pellets delivered into and sold wholesale within northern Italy based on transactions, market survey results and various types of other market information, including spread values between grades, locations, timings and other data. For more details, please refer to market data usage on page 2. Argus assesses the price of each contract on the basis of the greatest consensus of market information.

Price assessments are published as a mid-point with a high-low range. Reported trade is used to inform that range, but does not mechanically define it. The high-low range represents the highest and lowest transactions, or the range in which the contract could have traded during the period.

The assessment takes into account transactions and other market information for wholesale pellets delivered by ship, shipping container, lorry and other transportation to northern Italy, including ports and cities north of Florence.

Wood chips

Argus assesses wood chip spot and forward prices delivered into northwest Europe. Argus uses transactions, market survey results and various types of other market information to inform its assessments. Prices are assessed and published in €/GJ. For more details, see the market data use section on page 2.

Monthly averages

Argus publishes monthly averages of spot price indexes. Indexes are published for the current month and the two previous months.

Monthly averages are published for

Industrial wood pellets

- cif NWE (\$/t)
- fob Baltic (€/t)
- fob Portugal (€/t)
- fob Vietnam to South Korea (\$/t)
- fob Vietnam to Japan FIT (\$/t)
- cfr Gwangyang (\$/t)

Premium wood pellets

- del Italy bagged (€/t)
- del Italy bulk (€/t)

Palm kernel shell (PKS)

- fob east coast Sumatra to Japan FIT
- fob east coast Sumatra excl. to Japan FIT
- fob peninsular Malaysia to Japan FIT
- fob peninsular Malaysia excl. to Japan FIT

Wood chips

- cif NWE (€/GJ)

Break-even electricity prices

Wood pellet break-even prices are the price of power necessary to cover the fuel costs for a plant of the stated efficiency — the price of power at which the profit margin (or spark spread) for an unsubsidised plant operator would be zero.

Argus Biomass Markets publishes break-even generation costs for wood pellets for plants in northwest Europe using the Argus cif northwest Europe wood pellet spot index and the first forward calendar quarter price assessment on the day of publication.

For comparison, Argus Biomass Markets also publishes CO₂ emissions-adjusted break-even costs for coal-fired and gas-fired plants using the Argus spot and first forward quarter cif ARA coal and TTF gas price assessments. The spot gas price is calculated as the average of the first two forward calendar month assessments.

Quarterly breakeven costs roll forward on the first day of the quarter.

The coal, gas and CO₂ costs are based on an average of the relevant cif ARA coal, TTF gas and December delivery CO₂ price assessments in the week before publication of Argus Biomass Markets. See the [Argus Coal Daily International](#), [Argus European Natural Gas](#) and [Argus European Emissions Markets](#) methodologies. Calculations assume 0.341t/MWh of CO₂ emissions for coal and 0.202t/MWh for gas.

Power plant efficiencies

Prices are published at 36pc, 38pc, 40pc and 41pc efficiencies for biomass and coal break-even prices and at 49.13pc, 55pc, 58pc and 60pc efficiencies for gas break-even prices.

Currency conversion

Prices are converted into US dollar (\$) and euros (€) per megawatt hour for comparative purposes using the exchange rate on the day of publication.

Shipping costs

Wood pellet freight rates are assessed as a result of communication with leading shipping brokers and international traders of wood pellets. Rates may also be calculated according to reported differentials from fixtures on other routes. Rates are for a charter on day of publication for timing over the next 90 days. The following routes are covered:

- Aveiro-ARA 3,500t
- Aveiro-Copenhagen 3,500t
- Aveiro-Hull (UK) 3,500t
- Riga-ARA 5,000t
- Riga-Copenhagen 5,000t
- Riga-Stockholm 5,000t
- St Petersburg-ARA 3,500t
- St Petersburg-Copenhagen 3,500t
- St Petersburg-Stockholm 3,500t
- Mobile-ARA 25,000t
- Mobile-ARA 45,000t
- Savannah-ARA 25,000t
- Savannah-ARA 45,000t
- Vancouver-ARA 45,000t

European industrial biomass specifications

Argus Biomass Markets assesses industrial grade wood pellets, defined according to the Initiative Wood Pellet Buyers Group Industrial 2 specification below. Argus bases its prices on a 17 GJ/t pellet.

European wood pellets specifications

Parameters and rejection limits	Units	I2 industrial	
		Limit	Tolerance
Physical parameters			
Diameter	mm	6 to 10	within range
Length ≤50 mm	weight %	99.9%	within range
Length ≤40 mm	weight %	99%	within range
Water content	weight% ar	≤ 10 %	0.5% absolute
Bulk (apparent) density	kg/m ³	≥ 600	2% of limit
Maximum bulk temperature	°C	≤ 60	1°C
Net calorific value at constant pressure	GJ/tonne ar	≥ 16.5	0
Ash content	weight% DM	≤ 1.5%	10% of limit
Elementary composition			
Chlorine (Cl)	weight% DM	≤ 0.05 %	0.01% absolute
Nitrogen (N)	weight% DM	≤ 0.3 %	10% of limit
Sulphur (S)	weight% DM	≤ 0.2 %	20% of limit
Trace elements			
Arsenic (As)	mg/kg DM	≤ 2	0.064 absolute
Cadmium (Cd)	mg/kg DM	≤ 1	0.06 absolute
Chromium (Cr)	mg/kg DM	≤ 15	0.032 absolute
Copper (Cu)	mg/kg DM	≤ 20	0.043 absolute
Lead (Pb)	mg/kg DM	≤ 20	0.033 absolute
Mercury (Hg)	mg/kg DM	≤ 0,1	0.0046 absolute
Zinc (Zn)	mg/kg DM	≤ 200	5.43 absolute
Fines ≤ 3.15 mm (round hole sieves)	weight% ar	≤ 5 %	1% absolute
Durability	weight% ar	97.0-99%	0.5% absolute
Particle size distribution (square hole sieves)			
% < 3.15 mm	weight %	>98%	1% absolute
% < 2.0 mm	weight %	>90%	2% absolute
% < 1.0 mm	weight %	>50%	5% absolute

Argus Biomass Markets assesses industrial grade wood chips, defined according to the specifications below. Phytosanitation costs are not included in Argus' wood chip assessment.

Industrial wood chip specifications

Energy content	lower heating value/net calorific value in GJ
Ash content	3-4%
Chlorine	0.05%
Sulphur	0.05%
Size	97% of chips to be max size of 50x50x20mm

Premium wood pellets

Argus Biomass Markets assesses premium wood pellets, primarily for residential consumption that adhere to the EN plus A1 specification, per market practice.

For more details of EN plus specification see <http://www.enplus-pellets.eu/>.

Asia biomass specifications

Argus Biomass Markets assesses Asia-Pacific wood pellets manufactured from wood fibre exclusively, without any type of binder or other chemically treated biomass. The wood pellets meet the quality specification of South Korean generators.

Asian palm kernel shell specifications

Location: east coast Sumatra, peninsular Malaysia	
Unit(s):	\$/t
Contracts assessed:	Spot
Quantity:	8,000t minimum
Delivery: Bulk, handysize or container basis	
Total moisture (as received basis):	Max. 20pc wt
Net calorific value (as received basis):	Min. 3,500 kcal/kg
Ash (air dried basis):	Max. 4pc wt
Chlorine (air dried basis):	Max. 700ppm
Sulphur (air dried basis):	Max. 0.15pc wt
Foreign matter*:	Max. 1pc
*metallic materials and stones bigger than 4cm	

Asian industrial wood pellets specifications (to South Korea)

Location: Ho Chi Minh (Cat Lai), Haiphong, Hanoi, Quy Nhon	
Unit(s)	\$/t
Quantity	3,000t minimum
Delivery	Bulk basis or container basis
Dimension (mm)	D06, 6 ± 1 D08, 8 ± 1 D10, 10 ± 1 D12, 12 ± 1
Length (mm)	3.15 < L ≤ 40
Moisture (as received basis %)	≤ 10
Ash (as dried basis %)	≤ 5.0
Durability (as received basis %)	≥ 95.0
Fine (as received basis %)	≤ 6.0
Other additives (as received basis %)	< 3
Net calorific value (as received basis MJ/kg)	≥ 16.5
Bulk density (as received basis kg/m ³)	≥ 500
Nitrogen (as received basis %)	≤ 0.7
Sulphur (as dried basis %)	≤ 0.05
Chlorine (as dried basis %)	≤ 0.1
Arsenic (as dried basis mg/kg)	≤ 1.0
Cadmium (as dried basis mg/kg)	≤ 0.5
Chromium (as dried basis mg/kg)	≤ 10
Copper (as dried basis mg/kg)	≤ 10
Lead (as dried basis mg/kg)	≤ 10
Mercury (as dried basis mg/kg)	≤ 0.1
Nickel (as dried basis mg/kg)	≤ 10
Zinc (as dried basis mg/kg)	≤ 100

Asian industrial wood pellets specifications (Japan FIT)	
Location: Quy Nhon, Cat Lai, Vung Ang, Cai Lan, Dung Quat	
Unit(s)	\$/t
Quantity	10,000t minimum
Delivery	Bulk basis
Dimension (mm)	6-10
Length (mm)	≤ 40
Moisture (as received basis %)	≤ 10
Ash (as dried basis %)	≤ 1.5
Durability (as received basis %)	≥ 97
Fine (as received basis %)	≤ 5.0
Other additives (as received basis %)	< 2
Particle size distribution (as received basis %)	≤ 98
Net calorific value (as received basis MJ/kg)	≥ 16.5
Bulk density (as received basis kg/m ³)	≥ 600
Nitrogen (as received basis %)	≤ 0.3
Sulphur (as dried basis %)	≤ 0.2
Chlorine (as dried basis %)	≤ 0.05
Arsenic (as dried basis mg/kg)	≤ 2
Cadmium (as dried basis mg/kg)	≤ 1
Chromium (as dried basis mg/kg)	≤ 15
Copper (as dried basis mg/kg)	≤ 20
Lead (as dried basis mg/kg)	≤ 20
Mercury (as dried basis mg/kg)	≤ 0.1
Zinc (as dried basis mg/kg)	≤ 200
Sodium + Potassium (ppm)	≤ 2,000