METHODOLOGY AND SPECIFICATIONS GUIDE

argusmedia.com

ARGUS AIR DAILY

Contents:

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The most up-to-date Argus Air Daily 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 North American environmental 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 and directly from the back offices of market participants. Argus will accept market data by telephone, instant messenger, email 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. 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 North American environmental market prices are published in the Argus Air Daily report. Subsets of these prices appear in other Argus market reports and newsletters in various forms. 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.

Argus Air Daily

Argus Air Daily is a report on the North American environmental markets. It includes price assessments, transactional data, news, commentary, and analysis.

Price types

Bid: the best or highest available bid at the timestamp
Ask: the best or lowest available offer at the timestamp
Price: the midpoint of the bid and the ask, rounded to two decimal places
Low: the lowest price that traded during the trading day or, in the absence of trade, the lowest price that could have traded during the trading day
High: the highest price that traded during the trading day or, in the absence of trade, the highest price that could have traded during the trading day
VWA: a volume-weighted average of all validated trades that were transacted during the trading day
MTD VWA: a volume-weighted average of all validated trades that were transacted during the month to date

Timing:

Timestamp:
- California Carbon Allowances (CCAs): 6pm Washington DC time
- All others: 5pm Washington DC time

Trading day:
- California: 6am-6pm Washington DC time
- All other: 8am-5pm Washington DC time

Weekly and monthly indexes

Weekly indexes are calculated as the average daily price published for the respective assessment during the working week ending on the day of publication. Monthly indexes are calculated as the average daily price published for the named month.

Roll dates

Allowances, credits and certificates that are valid for a particular program year or vintage roll according to a set schedule, outlined in the table below.

Allowances, credits and certificates

Some assessments are for allowances, credits or certificates (instruments) that will be delivered to the buyer within a set timeframe. Where Argus stipulates a month of delivery, the assessment is of the price of instruments that will be delivered to buyer within that month. Where Argus stipulates "spot" delivery, assessments are of the price of instruments that will be delivered to buyer within the calendar month of publication.

Price assessments

Daily

Renewable energy certificate (REC): the price of a certificate for the generation of 1MWh of renewable power in Massachusetts (Class I, Solar), Connecticut (Class I), New Jersey (Class I, Solar), Pennsylvania (Tier I, Solar), Maryland (Tier I), or PJM (Class I) during the named year. Expressed in $/MWh.

SO2 and NOx allowances: the price of an allowance to emit one short ton of material during the named year, or during the named season of the named year under the named group of the Acid Rain Program or the Cross State Air Pollution Rule. Allowances for a group are valid for all states within that group. SO2 allowance prices are expressed in $/allowance for the Acid Rain program and $/st for the Cross-State Air Pollution Rule. NOx allowance prices are expressed in $/st.

California Carbon Allowance (CCA): the price of an allowance to emit one metric ton of CO2 equivalent (CO2e) during the named vintage year and delivered during the named month. Expressed in $/t.

California Low-Carbon Fuel Standard (LCFS): the price of an LCFS credit generated by a 1t reduction in carbon intensity. Expressed in $/t.

Oregon Low-Carbon Fuel Standard (LCFS): the price of an LCFS credit generated by a 1t reduction in carbon intensity. Expressed in $/t.

Regional Greenhouse Gas Initiative (RGGI) CO2 allowance: the price of an allowance to generate 1st of CO2 under the Regional Greenhouse Gas Initiative (RGGI). Expressed in $/st.

CER (secondary): see the Argus European Emissions Markets methodology.

Associated day-ahead power and natural gas markets: see the Argus US Electricity and Argus Natural Gas Americas methodologies.

Power
- NP15 peak
- NP15 off-peal
- SP15 peak
- SP15 off-peak

Natural Gas
- PG&E Citygates index
- SoCal Gas Co index

Weekly
Assessed and published on the last working day of the week, typically Friday.

Renewable energy certificate (REC): the price of a certificate for the generation of 1MWh of renewable power in Connecticut (Class III), New Jersey (Class II), California (Category 3), or Texas (Compliance) during the named vintage year. Expressed in $/MWh.

California carbon offset: the price of a single California carbon offset credit. Three-year invalidation credits are those that cannot be invalidated more than three years after the date the credit was generated. Seller-guaranteed credits are those sold with a guarantee against invalidation. Expressed in $/t.

Roll dates

Assessment	Vintage rolls on
Clean Air Act Title IV Acid Rain Program	
SO2	2 March
Cross-State Air Pollution Rule	
SO2 Group 1	2 March
SO2 Group 2	2 March
NOx annual	2 March
NOx Group 2 ozone season	2 March
Renewable Energy Certificates (RECs)	
Massachusetts	16 June
Connecticut	16 June
New Jersey	2 October
California	1 April
Pennsylvania	2 September
Maryland	1 April
Texas	1 April
PJM	2 October
California environmental markets	
Carbon Allowances VWA (CCAs)	26 December
Carbon Allowances year	2 January
Carbon Allowances prompt month	End of month-3 business days
Carbon offsets	
Alberta	1 April
Regional Greenhouse Gas Initiative (RGGI)	Compliance Period
Prompt month	2 March
Dec delivery (End of year)	1 January

Monthly

Alberta carbon offset: the price of a single Alberta carbon offset credit issued under the named protocol. Agricultural Tillage offset credits are generated under the conservation cropping protocol by shifts from conventional to conservation cropping which reduce emissions of CO2 and N2O.

Renewable Energy offset credits include offsets generated under a basket of protocols: the Wind-Powered Electricity Generation, Low-Retention, Water-Powered Electricity Generation as Run-of-the-River or an Existing Reservoir, Distributed Renewable Energy Generation and Solar Electricity Generation protocols. Expressed in C$/t and published on the last working day of the first working week of the month.

Calculated assessments

Prices are calculated and published daily.

California carbon price for gasoline, diesel
The per-gallon costs of compliance with the California cap-and-trade program for gasoline and diesel distributors.

Gasoline calculations assume a 10pc ethanol content.

Gasoline

Regular: ((CCA regular Carbob CO2 constant [summer (0.3686) or winter (0.3676)] x 0.9) + Carbob CH4 constant (0.0005425) + Carbob N2O constant (0.0061686)) x California CO2 month 1 carbon allowance price / 0.42

Midgrade: ((CCA midgrade Carbob CO2 constant [summer (0.3677) or winter (0.3676)] x 0.9) + Carbob CH4 constant (0.0005425) + Carbob N2O constant (0.0061686)) x California CO2 month 1 carbon allowance price / 0.42

Premium: ((CCA premium Carbob CO2 constant [summer (0.367) or winter (0.3679)] x 0.9) + Carbob CH4 constant (0.0005425) + Carbob N2O constant (0.0061686)) x California CO2 month 1 carbon allowance price / 0.42

Distillate

ULSD: (CCA diesel Carb CO2 constant (0.4296) + ULSD CH4 constant (0.00005) + ULSD N2O constant (0.000298)) x California CO2 month 1 carbon allowance price / 0.42

Quebec carbon price for gasoline, diesel

The per-liter costs of compliance with Quebec's cap-and-trade program for gasoline and diesel. Calculations assume that a Quebec carbon allowance has the same price as a California carbon allowance. Gasoline calculations assume a 5pc ethanol content.

Gasoline

California CO2 month 1 carbon allowance price x Quebec carbon gasoline factor constant (0.002361) x USD/CAD exchange rate x 100 x 0.95

Diesel

California CO2 month 1 carbon allowance price x Quebec carbon diesel factor constant (0.003007) x USD/CAD exchange rate x 100

California LCFS premium per carbon intensity point

The cost savings, under the California LCFS program, of using ethanol or biodiesel. Denominated in ¢/USG.

Ethanol

Energy density of ethanol (81.51) x California LCFS credits price x 100 / 1,000,000

Biodiesel

Energy density of biodiesel (126.13) x California LCFS credits price x 100 / 1,000,000

California LCFS cost for gasoline, diesel

The per-gallon costs for an obligated party to comply with the California LCFS program for the current year and two forward years. Costs are calculated in two ways.

- Assumes a 10pc ethanol content and assumes ethanol is cost neutral, generating neither credits nor deficits.
- Assumes a 10pc ethanol content and that ethanol has a carbon intensity of 79.9g/megajoule.

Carbob

For ethanol with no CI score

(Carb official Gasoline LCFS target constant for named year – gasoline carbon intensity constant (99.78)) x gasoline energy density constant (119.53) x California LCFS credits prompt price / gasoline factor constant (1,000,000) x -100 x 0.9

For ethanol with 79.9 CI score

(((Carb official Gasoline LCFS target constant for named year – gasoline carbon intensity constant (99.78)) x gasoline energy density constant (119.53) x 0.9) + ((Carb official Gasoline LCFS target constant for named year – ethanol carbon intensity (79.9)) x ethanol energy density constant (81.51) x 0.1)) x California LCFS credits prompt price / gasoline factor constant (1,000,000) x -100

ULSD

(Carb official Diesel LCFS target constant for named year – diesel carbon intensity constant (102.01)) x diesel energy density constant (134.47) x California LCFS credits prompt price / diesel factor constant (1,000,000) x -100

For Carb official LCFS target constants see www.arb.ca.gov.

California price for biogas, fossil gas

The total value on a $/mn Btu basis of biogas and fossil gas (conventional natural gas) sold into California for use as a transportation fuel. This includes the value of credits awarded to biogas under the California Low-Carbon Fuel Standard (LCFS) and of renewable identification numbers (RINs) under the federal Renewable Fuel Standard.

Biogas: Gas commodity value + (Cellulosic biofuel RINs price x US EPA RINs per mn Btu constant (11.73)) + (California LCFS credit price x Carb LCFS credits per mn Btu constant for named year)

Fossil natural gas: Gas commodity value + (California LCFS credit price x Carb LCFS credits per mn Btu constant for named year)

RIN cellulosic biofuel current year
See the Argus Americas Biofuels methodology

Natural gas hub PG&E Citygates day-ahead index
Natural gas hub SoCal Gas Citygates day-ahead index
See the Argus Natural Gas Americas methodology

For Carb carbon intensity, energy economic ratio, low- and high-heating value numbers and scf to mn Btu factor used to calculate LCFS credits per mn Btu see www.arb.ca.gov. For EPA Btu to USG factor used to calculate the RINs per mn Btu constant see www.epa.gov.

Oregon LCFS premium per carbon intensity point

The cost savings, under the Oregon LCFS program, of using ethanol or biodiesel. Denominated in ¢/USG.

Ethanol

Energy density of ethanol (81.51) x Oregon LCFS credits price x 100 / 1,000,000

Biodiesel
Energy density of biodiesel (126.13) x Oregon LCFS credits price x 100 / 1,000,000

Oregon LCFS cost for gasoline, diesel
The per-gallon costs for an obligated party to comply with the Oregon LCFS program. The gasoline calculation assumes a 10pc ethanol content. The diesel calculation assumes a 5pc biodiesel content.

Gasoline
(Oregon DEQ official Gasoline LCFS target constant for named year – gasoline E10 carbon intensity constant (98.64)) x gasoline energy density constant (118.38) x Oregon LCFS credits prompt price / gasoline factor constant (1,000,000) x -100

Diesel
(Oregon DEQ official Diesel LCFS target constant for named year – B5 diesel carbon intensity constant (99.61)) x diesel energy density constant (134.06) x Oregon LCFS credits prompt price / diesel factor constant (1,000,000) x -100

For DEQ official LCFS target constants see http://www.oregon.gov/deq/

Adjusted California heat rates and carbon cost

Gas-implied
Heat rate: the least efficient gas-fired plant (measured in heat rate) that could operate economically in the named market at the day's gas and power prices, assuming non-compliance with carbon regulations.

Carbon cost: the cost of the carbon allowances that the same plant would need to buy in order to comply with carbon regulations.

Carbon-adjusted
Heat rate: the least efficient gas-fired plant (measure in heat rate) that could operate economically in the named market at the day's gas and power prices, assuming compliance with carbon regulations.

Carbon cost: the cost of the carbon allowances that the same plant would need to buy in order to comply with carbon regulations.

Power exports to California: The cost of the carbon allowances needed in order to comply with carbon regulations for power exports to California from the named source market.

NP-15 heat rates
Gas-implied: named electricity price / PG&E gas price
Carbon-adjusted: named electricity price / PG&E gas price + current year California CO2 carbon allowance x emissions rate constant (0.053165)

NP-15 carbon cost
Gas-implied: (named electricity price / PG&E gas price) x emissions rate constant (0.053165) x current year California CO2 carbon allowance

Carbon-adjusted: named electricity price / (PG&E gas price + current year California CO2 carbon allowance x emissions rate constant (0.053165)) x emissions rate constant (0.053165) x current year California CO2 carbon allowance

SP-15 heat rate
Gas-implied: named electricity price / SoCal gas price
Carbon-adjusted: named electricity price / (SoCal gas price + current year California CO2 carbon allowance x emissions rate constant (0.053165))

SP-15 carbon cost
Gas-implied: named electricity price / SoCal gas price x emissions rate constant (0.053165) x current year California CO2 carbon allowance

Carbon-adjusted: named electricity price / (SoCal gas price + current year California CO2 carbon allowance x emissions rate constant (0.053165)) x emissions rate constant (0.053165) x current year California CO2 carbon allowance

Exports to California from Western Electric Coordinating Council: current year California CO2 carbon allowance x Carb official unspecified emission factor

Exports to California from Bonneville Power Administration: current year California CO2 carbon allowance x Carb official ACS BPA emission factor for named year

Exports to California from Powerex electric: current year California CO2 carbon allowance x Carb official ACS PowerEx emission factor for named year

For Carb official emissions factors see www.arb.ca.gov.

Adjusted spark spreads
Gas-implied: The gross margin for a gas-powered plant, implied by the difference between power prices and fuel costs at various heat rates.

Carbon cost: The cost of CO2 allowances required for compliance with the California Cap-and-Trade program for a gas-powered plant at various heat rates.

Carbon-adjusted gas-implied: The gas-implied spark spread less the carbon cost at the associated heat rate.

NP-15 gas-implied
7,000 heat rate: NP-15 day ahead electricity price – 7 x PG&E day ahead gas price

8,000 heat rate: NP-15 day ahead electricity price – 8 x PG&E day ahead gas price

10,000 heat rate: NP-15 day ahead electricity price – 10 x PG&E day ahead gas price

12,000 heat rate: NP-15 day ahead electricity price – 12 x PG&E day ahead gas price

NP-15 carbon-adjusted

7,000 heat rate: NP-15 day ahead electricity price – (current year California CO2 carbon allowance x emissions rate constant (0.053165) x 7) + (7 x PG&E Citygates day ahead gas price)

8,000 heat rate: NP-15 day ahead electricity price – (current year California CO2 carbon allowance x emissions rate constant (0.053165) x 8) + (8 x PG&E Citygates day ahead gas price)

10,000 heat rate: NP-15 day ahead electricity price – (current year California CO2 carbon allowance x emissions rate constant (0.053165) x 10) + (10 x PG&E Citygates day ahead gas price)

12,000 heat rate: NP-15 day ahead electricity price – (current year California CO2 carbon allowance x emissions rate constant (0.053165) x 12) + (12 x PG&E Citygates day ahead gas price)

SP-15 gas-implied

7,000 heat rate: SP-15 day ahead electricity price – 7 x SoCal day ahead gas price

8,000 heat rate: SP-15 day ahead electricity price – 8 x SoCal day ahead gas price

10,000 heat rate: SP-15 day ahead electricity price – 10 x SoCal day ahead gas price

12,000 heat rate: SP-15 day ahead electricity price – 12 x SoCal day ahead gas price

SP-15 carbon-adjusted

7,000 heat rate: SP-15 day ahead electricity price – (current year California CO2 carbon allowance x emissions rate constant (0.053165) x 7) + (7 x SoCal day ahead gas price)

8,000 heat rate: SP-15 day ahead electricity price – (current year California CO2 carbon allowance x emissions rate constant (0.053165) x 8) + (8 x SoCal day ahead gas price)

10,000 heat rate: SP-15 day ahead electricity price – (current year California CO2 carbon allowance x emissions rate constant (0.053165) x 10) + (10 x SoCal day ahead gas price)

12,000 heat rate: SP-15 day ahead electricity price – (current year California CO2 carbon allowance x emissions rate constant (0.053165) x 12) + (12 x SoCal day ahead gas price)

California carbon cost

7,000 heat rate: current year California CO2 carbon allowance x emissions rate constant (0.053165) x 7

8,000 heat rate: current year California CO2 carbon allowance x emissions rate constant (0.053165) x 8

10,000 heat rate: current year California CO2 carbon allowance x emissions rate constant (0.053165) x 10

12,000 heat rate: current year California CO2 carbon allowance x emissions rate constant (0.053165) x 12

Currency exchange

US dollar/Canadian dollar conversions use the USD/CAD exchange rate as posted by the Bank of Canada at 4:30pm Ottawa time.