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# ***ARGUS NORTH AMERICAN ELECTRICITY IMPLIED VOLATILITY FORWARD CURVES***

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The most up-to-date Argus North American Electricity Implied Volatility Forward Curves methodology is available on [www.argusmedia.com](http://www.argusmedia.com)

## Introduction

Argus Media is a price reporting organization recognized throughout the world for its impartial, reliable and accurate coverage of key energy commodity markets. Argus price indices are used extensively in natural gas and electricity markets in Europe and globally for crude oil, refined products, coal and environmental markets such as emissions credits.

Argus North American Electricity Implied Volatility Forward Curves "Argus Electricity Volatilities" represent the market's current volatility valuation for call, put and straddle options, on a monthly basis. Implied volatility is a measure of variation in price derived from observed option prices for a specific forward contract time period. Argus Electricity Volatilities are derived from market option prices and differ from historical volatility curves, which are calculated from the historical market prices of the underlying commodity.

Argus Volatility Curves provide an assessment of implied volatilities at major natural electricity locations and/or hubs across North America, including those markets and/or tenors where minimal liquidity exists on a given trading day.

Argus Electricity Volatilities are an essential tool for valuing option premiums. Argus Electricity Volatilities can also be used in mark-to-market accounting, and numerous analytical applications such as value-at-risk, potential future exposure, deal valuation, regression analysis, scenario analyses, etc.

Argus Electricity Volatilities include daily assessments for 19 electricity trading locations, providing monthly granularity for time periods extending a minimum of two years forward. Argus provides implied volatilities at current market prices using "At the Money" (ATM) strike prices for all 19 electricity locations assessed. The strike price is the price at which a specific derivative contract can be bought or sold, also known as the exercise price. A call option strike price is the price at which a derivative can be bought, while a put option strike price is the price at which the derivative can be sold. In addition, Argus Electricity Volatilities provide implied volatilities above and below the current market price, for six major electricity trading hubs (PJM West Hub, Mass Hub, Indiana Hub, ERCOT North Zone, SP-15 and Mid-C) creating a volatility smile. Volatility smile is a pattern in which ATM options tend to have lower implied volatilities than in-the-money (ITM) or out-of-the-money (OTM) options, which results from the probability of extreme price fluctuations. An ITM call option's strike price is below the market price of the underlying derivative contract, while an ITM put option's strike price is above the market price of the underlying derivative contract. An OTM call option's strike price is above the market price of the underlying derivative contract, while an OTM put option's strike price is below the market price of the underlying derivative contract. The volatility smile strike prices are in increments of \$2.00/MWh, at and below the current market price. Argus uses Black-Scholes model as the underlying method for calculating electricity implied volatilities. Argus uses the London Interbank Offered Rate (LIBOR) as its interest rate benchmark index. LIBOR is the average interest

rate charged by banks' lending to other banks, and is estimated by the leading banks in London. LIBOR is the primary benchmark, along with the Euribor, for short term interest rates around the world. Argus calculates implied volatilities using a calendar (365 days) time to maturity for all options observed.

Argus produces electricity implied volatility forward curves on every trading day in which the CME's Henry Hub Natural Gas Futures market is open for trading during normal business hours. Argus Electricity Volatilities are not published on CME holidays.

## Code of Conduct and Compliance

Argus operates a rigorous and transparent controls framework to govern its price reporting activities. This is underpinned by its global compliance policy ([www.argusmedia.com](http://www.argusmedia.com)) and which includes an ethics policy and a business continuity plan. This strict ethics policy can be found on Argus' website at [www.argusmedia.com](http://www.argusmedia.com). Included in this policy are restrictions against Argus employees trading in any energy commodities, including the equities of energy industry participants, and guidelines for the acceptance of gifts from non-Argus individuals and entities. Argus also has strict policies regarding the archiving of email and instant messenger communications, maintenance and archiving of notes and for the archiving of spread sheets and deal lists used in the price index formation process.

The company's Global Compliance Officer oversees the compliance framework, including a rolling program of internal audits to ensure compliance with stated methodologies and policies.

## Methodology

### Liquid Electricity Forward Markets

Argus Electricity Volatilities reflect market value as of 2:30pm EST, consistent with NYMEX natural gas futures primary trading session, providing consistency and corresponding with the CME closing prices for any given trading day.

Argus gathers information on forward option markets from numerous sources, including brokers, traders and through the mid- and back offices of energy companies. Argus uses electricity option transactions, bids and offers, option spreads, straddle options, collars and other financial data to derive its final implied volatility forward curve assessment.

Market information is cross-checked and validated to ensure the accuracy of the data. Information that Argus cannot validate may be excluded from the assessment process. Transactions done after 2:30pm EST are not considered for that trading day's forward curve assessments.

Executed transactions are typically used as the final forward curve value in the absence of additional information. For markets and terms where end of day bids and/or offers are available, the last

executed transaction may be ignored if it falls outside the prevailing bid/offer range. In the event there is only a bid or offer available, the transaction price must be lower than the offer price and/or greater than the bid price. In situations where both a bid and offer are available, but no transactions, Argus determines value as being at the midpoint of the bid/offer spread, assuming the bid offer spread is not wider than what Argus determines is a normal bid/offer spread for a particular market location and term. If the bid/offer spread is considered to be wider than is normally the case, Argus will value the curve within the bid/offer spread but will not necessarily value the curve at the midpoint.

### **Illiquid Electricity Forward Markets**

In the absence of any market information for a particular location and/or term on a given day, Argus will seek to establish if the location typically trades on a spread basis to another, more liquid, electricity market. At times, Argus may use proprietary curve valuation models that utilize advanced statistical analyses to formulate implied volatility curves in cases in which no market information is available for a particular market location and/or term. Argus constantly reviews markets, liquidity and trading patterns to ensure its forward curve valuations are in line with energy market information needs.

### **Definition of Forward Implied Volatility Contracts**

#### **Monthly**

Monthly electricity contracts are for the contracted volume of electricity divided by the number of days in a given month. This daily required volume of electricity is then delivered rateably over a 24 hour delivery schedule for every day during the contracted delivery month.

**Trading Locations for Argus North American Electricity Forward Price Curves**

**East Markets:**

**NYISO Zone A**

Other IDs: Zone A  
 Details: New York ISO Zone-A hub consists of four sub-regions where power is delivered into western NY state.  
 Grid operator: New York ISO  
 Market structure: Nodal LMP  
 Product(s) assessed: Financial swap settled against NYISO day-ahead market clearing price.  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: Hours ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

**NYISO Zone G**

Other IDs: Zone G, Hudson Valley  
 Details: New York ISO Zone-G hub consists of four sub-regions where power is delivered into New York's lower Hudson Valley.  
 Grid operator: New York ISO  
 Market structure: Nodal LMP  
 Product(s) assessed: Financial swap settled against NYISO day-ahead market clearing price.  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: Hours ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

**NYISO Zone J**

Other IDs: Zone J, NYC  
 Details: New York ISO Zone-J hub consists of four sub-regions where power is delivered into New York City.  
 Grid operator: New York ISO  
 Market structure: Nodal LMP  
 Product(s) assessed: Financial swap settled against NYISO day-ahead market clearing price.  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: Hours ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

**PJM West Hub**

Other IDs: PJM Western Hub, PJM-W, West Hub  
 Details: The PJM Western hub pricing point comprises a basket of 115 nodes stretching from Erie, Pennsylvania, to Washington, D.C.  
 Grid operator: PJM Interconnection  
 Market structure: Nodal LMP  
 Product(s) assessed: Firm physical power with liquidated damages  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

**PJM East Hub**

Other IDs: East Hub, PJM East  
 Details: The PJM East Hub comprises the basket of nodes east of PJM West Hub  
 Grid operator: PJM Interconnection  
 Market structure: Nodal LMP  
 Product(s) assessed: Financial day-ahead power, financially settled against PJM's East Hub day-ahead LMP  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

**PJM PEPCO Zone**

Other IDs: PEPCO  
 Details: PJM PEPCO Zone located within PJM's East Hub territory  
 Grid operator: PJM Interconnection  
 Market structure: Nodal LMP  
 Product(s) assessed: Financial day-ahead power, financially settled against PJM's PEPCO Zone day-ahead LMP  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

**PJM PSEG Zone**

Other IDs: PSEG  
 Details: PJM PSEG Zone located within PJM's East Hub territory  
 Grid operator: PJM Interconnection  
 Market structure: Nodal LMP  
 Product(s) assessed: Financial day-ahead power, financially settled against PJM's PSEG Zone day-ahead LMP  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

**PJM JCPL Zone**

Other IDs: JCPL, Jersey City Power & Light  
 Details: PJM JCPL Zone located within PJM's East Hub territory  
 Grid operator: PJM Interconnection  
 Market structure: Nodal LMP  
 Product(s) assessed: Financial day-ahead power, financially settled against PJM's JCPL Zone day-ahead LMP  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

### PJM PPL Zone

Other IDs: PPL  
 Details: PJM PPL Zone located within PJM's East Hub territory  
 Grid operator: PJM Interconnection  
 Market structure: Nodal LMP  
 Product(s) assessed: Financial day-ahead power, financially settled against PJM's PPL Zone day-ahead LMP  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

### ISO-NE Mass Hub

Other IDs: Mass Hub, NEPOOL, Massachusetts Hub, ISO New England Internal Hub, Internal Hub  
 Details: The NE Pool hub pricing point comprises about 30 nodes located in central Massachusetts that represent much of the bilateral power trading that occurs within the six-state New England region.  
 Grid operator: ISO New England  
 Market structure: Nodal LMP  
 Product(s) assessed: Firm physical power with liquidated damages  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

### Central Markets:

#### MISO Indiana Hub

Other IDs: Indiana, Indiana Hub  
 Details: Indiana pricing hub comprises 182 nodes and replaced the former Cienergy hub.  
 Grid operator: Midwest Independent System Operator (MISO)  
 Market structure: Nodal LMP  
 Product(s) assessed: Firm physical power with liquidated damages  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

#### PJM NI Hub

Other IDs: NILL, Northern Illinois Hub  
 Details: The PJM Northern Illinois pricing hub comprises 232 nodes located in the Commonwealth Edison control area in northern Illinois.  
 Grid operator: PJM Interconnection  
 Market structure: Nodal LMP  
 Product(s) assessed: Firm physical power with liquidated damages  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

### PJM AD Hub

Other IDs: PJM AD, AEP Dayton, AD  
 Details: The PJM AEP Dayton pricing hub comprises 1,161 nodes found in the American Electric Power and Dayton Power and Light control areas in Ohio and Michigan.  
 Grid operator: PJM Interconnection  
 Market structure: Nodal LMP  
 Product(s) assessed: Firm physical power with liquidated damages  
 Peak hours: Hours ending 8 through 23, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: ending 1 through 7 and 24, Mon-Fri, plus all hours of weekends and NERC holidays

### ERCOT North Zone

Other IDs: North, NZ  
 Details: Represents transactions within ERCOT's North Generation Zone.  
 Grid operator: Electric Reliability Council of Texas (ERCOT)  
 Market structure: Nodal LMP  
 Product(s) assessed: Firm physical power with liquidated damages  
 Peak hours: Hours ending 7 through 22, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: Hours ending 1 through 6 and 23 through 24, Mon-Fri, plus all hours of weekends and NERC holidays

### ERCOT South Zone

Other IDs: South, SZ  
 Details: Represents transactions within ERCOT's South Generation Zone.  
 Grid operator: Electric Reliability Council of Texas (ERCOT)  
 Market structure: Nodal LMP  
 Product(s) covered: Firm physical power with liquidated damages  
 Peak hours: Hours ending 7 through 22, Mon-Fri (excluding all NERC holidays)  
 Off-peak hours: Hours ending 1 through 6 and 23 through 24, Mon-Fri, plus all hours of weekends and NERC holidays

### West Markets:

#### WSPP Mid C

Other IDs: Mid C Mid-Columbia  
 Details: Mid-Columbia is a general reference to power trading at five hydroelectric dams along a 118-mile stretch of the Columbia River in the Pacific Northwest. The five dams are operated by the PUDs for Chelan, Douglas, and Grant counties in Washington state.  
 Grid operator: Various utilities in the region act as balancing authorities  
 Market structure: No organized market  
 Product(s) assessed: Firm physical power with liquidated damages  
 Peak hours: Hours ending 7 through 22, Mon-Sat (excluding all NERC holidays)  
 Off-peak hours: Hours ending 1 through 6 and 23 through 24, Mon-Sat, plus all hours of Sundays and NERC holidays

### WSPP NP15

Other IDs: NP 15, North of Path 15, North Path, NP

Details: The NP-15 hub pricing point comprises nodes within CAISO's former northern congestion zone, the area north of the Path 15 AC transmission line.

Grid Operator: California Independent System Operator (CAISO)

Market structure: Nodal LMP

Product(s) assessed: Firm physical power with liquidated damages

Peak hours: Hours ending 7 through 22, Mon-Sat (excluding all NERC holidays)

Off-peak hours: Hours ending 1 through 6 and 23 through 24, Mon-Sat, plus all hours of Sundays and NERC holidays

### WSPP Palo Verde

Other IDs: Palo Verde, PV, Palo

Grid operator: Various utilities in the region act as balancing authorities

Market structure: No organized market

Product(s) assessed: Firm physical power with liquidated damages

Peak hours: Hours ending 7 through 22, Mon-Sat (excluding all NERC holidays)

Off-peak hours: Hours ending 1 through 6 and 23 through 24, Mon-Sat, plus all hours of Sundays and NERC holidays

### WSPP SP 15

Other IDs: SP 15, South-of-Path 15, South Path, SP

Details: The SP-15 hub pricing point comprises nodes within CAISO's former southern congestion zone, the area south of the Path 15 AC transmission line.

Grid operator: Independent System Operator (CAISO)

Market structure: Nodal LMP

Product(s) assessed: Firm physical power with liquidated damages

Peak hours: Hours ending 7 through 22, Mon-Sat (excluding all NERC holidays)

Off-peak hours: Hours ending 1 through 6 and 23 through 24, Mon-Sat, plus all hours of Sundays and NERC holidays

### Contact Information:

For methodological questions about Argus North American Electricity Implied Volatility Forward Curves, please contact Al Pollard, Vice-President of Risk Management Products, at 713-429-6338; [al.pollard@argusmedia.com](mailto:al.pollard@argusmedia.com).

For questions about how you can begin receiving Argus North American Electricity Implied Volatility Forward Curves, please contact the Argus sales team at:

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