Settlement Price Regulation of

HUDEX Hungarian Derivative Energy Exchange Ltd.

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1. Settlement price calculation principles

1.1. Settlement prices on HUDEX Power Segment

On each Trading Day, for traded Contracts on the HUDEX power segment, a Settlement Price is calculated by HUDEX. In case the traded Contract cascades into Contracts with shorter Delivery Periods, a Settlement Price for those shorter periods will also be calculated.

During the Delivery Period of the Contract the HUPX DAM index prices will be the basis of the Settlement Price calculation. The final Settlement Prices calculated on the last day of the Delivery Period for non-cascading Products will be equivalent, in all instances, with the average daily HUPX DAM hourly prices for the Delivery Period of the given Contract, rounded to two decimals.

The Settlement Price serves as input for the daily margining process at the Clearing House.

1.2. Theory and method

The basic inputs of the settlement price calculation are the HUDEX power segment market data for the relevant trading day (trading and bidding activity), economically equal products on other exchanges and OTC broker data for the trading day (trading and bidding activity), other publicly available market indices, HUDEX member indications and the settlement price of the previous trading day.

Essentially, for the determination of daily settlement prices HUDEX uses the market data of the HUDEX power segment, within the relevant settlement window, specified in section 2.1 of this document. This data could be then modified by adding the trading and bidding activity of economically equal products on other exchanges and trading activity on the OTC broker platforms, creating a pool of inputs. These inputs will be ranked and weighted by different attributes along three factors: time, volume and spread.

Bid and ask inputs will form a bid-ask pair, which will be treated as a potential trade, according to the three ranking attributes mentioned above. A trade's bid-ask spread is zero, thus its weight will be the highest weight (1) which can be given to this attribute, otherwise a bid-ask pair's spread volume can range from 0 - 1 Euro exponentially.

From the three attributes' calculated weight-rate, HUDEX defines a quality number for every contract using harmonic mean calculation method. The aggregated value of these individual contracts' quality will result in a Quality SUM, which will indicate how strong the primary inputs are. In case there is not enough information available from the primary inputs in order to calculate a settlement price, HUDEX will use secondary inputs. Secondary inputs are indications from the OTC brokers, HUDEX members and other publicly available market indices.

In case there is no primary input (bid-ask pairs and/or trades) available, the price determination will be based on a technical price. This takes into account the settlement price of the previous day for the corresponding contract.

The settlement price should be free from arbitrage and placed between the last observed bid-ask value on HUDEX power segment at the end of the Settlement Window.

1.3. Minimum number of settlement prices

HUDEX determines settlement prices for the following tradable contracts at least:

- Day: front 1
- Weekend: 0
- Week: front 4
- Month: front 3
- Quarter: front 4
- Year: front 3

Besides these contracts HUDEX defines settlement prices for the contract under delivery (current week and current month) and the final settlement prices when they are available.

HUDEX publishes settlement prices for each contracts with open positions.

2. Calculation process

2.1. Settlement window

Settlement window: trades and bid-asks will be consider during the settlement price calculation only if they were submitted or concluded within the defined time frame.

The settlement window is: **between 8:00 am and 5:00 p.m**

2.2. Steps of the calculation

The detailed steps of the calculations are the following:

No.	Calculation level	Comment
1	**Primary SP inputs**	1.1, in absent 1.2, in absent 1.3
1.1	SP Estimate	Primary inputs: - firstly: HUDEX Trades, BA (=bid-ask pairs) - secondly: trades of economically equivalent products on other Exchanges, OTC Broker Trades, BA **-> Price Estimate** and **Quality sum**
1.2	HUDEX Technical Price	(if no SP estimate available) **-> Price Estimate = Last SP +** any fixed deviation if the contract is in arbitrage with a contract in arbitrage, which price has moved since the last calculation
1.3	Incoming Product Handling	in the absence of Last SP (e.g. when the trading period of a product starts), based on the settlement prices of other, connected contracts
2	**Secondary SP inputs**	weighted average of 2.1 and 2.2
2.1	OTC broker inputs and indices	OTC broker closing BA and other publicly available indices
2.2	Indications	HUDEX member indications
3	**Preliminary SP1**	**1** - if Quality Sum > SQS (Sufficient Quality Sum) **weighted average of 1 & 2** - if Quality Sum < SQS
4	**Preliminary SP2**	Settling between the BA at HUDEX
5	**Arbitrage Free SP**	Arbitrage free results
6	**Final SP**	Final SP, validated by the market operators

3. Parameters for Primary SP inputs

For the most accurate settlement price results, HUDEX uses a wide variety of parameters for different delivery periods and phases of the calculation.

3.1. Bid-Ask parameters

The corresponding Bid and Ask pairs for the same contract will be classified as a trade in order to rank and weight them along the same three attributes (=quality parameters) as actual trades. While trades have exact volumes and prices, Bid/Ask pairs will have two different volumes and prices. HUDEX takes the minimum of the two volumes, and uses the average of the two prices, so called bid-ask MID.

The pairing rules and parameters for this process are the following:

Parameter	Value	Explanation
minimum_duration_of_offers	0:03:00	What is the longest time, when HUDEX considers a Bid or Ask to be a serious offer. This parameter tries to cross out those actions, when someone puts in an offer for a moment than immediately takes it off.
lookback	0:15:00	The maximum time difference between the paired Bid and Ask timestamp.
minimum_duration_of_paired_offers	0:00:01	What is the minimum duration that the same best Bid lasts against same best Ask.

Lookback rule is not applied in case of HUDEX orders.

3.2. Quality Parameters

As the first step HUDEX weights the inputs along the three attributes: time, volume and spread. From every valuable primary input, HUDEX calculates an estimated price (=SP estimate) for each individual product.

Time and spread rates have exponential weighting while volume has linear.

Parameter	Explanation
spread_divisor	How much spread [EUR/MWh] drops the spread quality's value to half. This parameter can be set for every product, so its value may vary.
time_divisor	How much time should pass [hours], counting from the closing time of the settlement window, for the time quality's value to drop to half. This value can also be set differently for every product, so it may vary.
spread_zerotrsh	It means that above this spread the value of the spread quality parameter will be defined as zero.
volume weight	The quantity [MW] which makes the volume quality's value maximal. This value can also be set differently for every product, so it may vary.

The calculation parameters for the different delivery periods are the following:

Parameter	Day	Weekend	Week	Month	Quarter	Year
spread_divisor	2,00	2,00	0,75	0,75	0,50	0,50
spread_zerotrsh	4,00	4,00	0,75	0,50	0,50	0,50
time_divisor	0,7	0,7	0,7	0,7	0,7	0,7
time_zerotrsh	10	10	10	10	10	10
volume weight	5	5	5	5	5	5

After ranking and weighting the primary inputs in the first phase of the settlement price calculation, HUDEX sorts them out using a Quality SUM, which is simply the sum of the individual trade and created bid-ask pair qualities (for the corresponding product). The intention is to indicate the strength of the primary inputs.

Parameter	Value	Explanation
Sufficient quality sum	1	This value shows how high the Quality SUM should be, in order to call it sufficient and strong. If it is equal or larger, then there is no need for the other, secondary inputs.

3.3. Technical prices and incoming product handling

In case there are no primary inputs available (Quality sum = zero), HUDEX defines a technical price for that contract. The technical price is based on the previous settlement price of that contract. If the contract is in arbitrage with a contract in arbitrage, which price has moved since the last trading day, the technical prices will be equal to the last settlement price shifted with the deviation from the superior contract SP change.

Example: There is a year contract where the price has been changed +0,5 %, then the last settlement price of the quarter contract (without primary inputs, bid-ask mid nor trades) *in arbitrage* would be shifted by 0,5 %.

Parameter	Value	Explanation
Price_shift_factor	1	This value shows the ratio of the price shifting in case of technical price determination

If there is no contract in connection (e.g. week contracts) the technical price is equal to the last settlement price.

In case there were primary inputs available the technical price will not be taken into consideration.

For contracts without any primary inputs and without last settlement price, HUDEX determines the technical price based on the settlement prices of the connecting contracts.

4. Parameters for Secondary SP inputs

If the Quality SUM of a contract is not enough to reach the value of the Sufficient Quality SUM then HUDEX utilizes the Secondary SP inputs.

Secondary SP inputs are:

- OTC Broker inputs and other publicly available indices
- HUDEX Member indications

The weighted average of these two inputs is the secondary price, which is used in the second phase of the settlement price calculation. HUDEX may set the weight, which is used to define the average of these two inputs by the following parameter:

Parameter	Value	Explanation
Weight_OTC_Broker_vs_HUDEX Member Indications	1	This value shows the weight-rate difference between the Broker inputs and indices and the Member Indications. 1 means the two inputs are weighted equally in the average, if it's 2 than the Broker input weight is 2/3 and the other's is 1/3, etc …

In order to prevent any market participant from unduly influencing the final settlement price and the usage of irrelevant market indications, HUDEX may apply filters on the secondary inputs. These filters may be applied if the secondary inputs are significantly different from the primary inputs or from the other secondary inputs.

5. Price determination

5.1. Preliminary SP1

HUDEX set the weight used in the average between Primary Price Estimates and Secondary SP inputs. In this phase of the calculation, the weighted average of this two produce the Preliminary SP1.

Parameter	Value	Explanation
Weight_Primary Estimates_vs_Secondary SP inputs	0,75	This value shows the weight-rate difference between Primary Price estimates and Secondary SP inputs. 1 means the two inputs are weighted equally in the average, if it's 2 than the Primary weight is 2/3 and the other's is 1/3, etc …

5.2. Preliminary SP2

HUDEX checks whether the preliminary SP1 is set between the active bid-ask orders on the HUDEX screen at the end of the settlement window. The observed timeframe is: 15 minutes before the end settlement window, between 16:45 and 17:00. If the preliminary SP1 is not lower than the best bid and not higher than the best ask the preliminary SP1 is equal to preliminary SP2.

In case the preliminary SP1 is out of the range the preliminary SP2 will be defined as + 0,01 eurocent to the best bid or 0,01 eurocent to the best ask.

5.3. Arbitrage Free SP

The settlement price must be arbitrage free. In order to define arbitrage free settlement prices it may be needed to slightly shift the preliminary SP2. There is an allowed playing field where the preliminary prices can be moved.

Parameter	Value	Explanation
Max price chg (without trades, BA) (%)	3 %	This value shows maximum price movement from the preliminary SP2 in order to have arbitrage free settlement prices, when there was no primary input for the contract
Max price chg (with trades, BA) (%)	0,05 %	This value shows maximum price movement from the preliminary SP2 in order to have arbitrage free settlement prices when there were primary inputs for the contract

Non-arbitrage is ensured in case a difference of EUR 0.00 between the Contracts with an overlapping due date after standard rounding.

5.4. Final SP

The HUDEX market operators need to validate the results of the calculation. HUDEX is entitled to modify the settlement price, thus preventing market price deviations and following the settlement price calculation rules defined in the prevailing HUDEX Market Rules.

6. Settlement price calculation during the delivery period

HUDEX is required to calculate settlement prices for the week and month contracts under delivery. During the delivery period these contracts are not tradable, the price is calculated based on the settlement price on the last trading day and the average of the available HUPX day-ahead hourly prices.

$$SP = \frac{number\ of\ passed\ hours}{number\ of\ total\ hours} * average\ HUPX\ DAM\ price\ of\ passed\ hours$$
$$+ \left(1 - \frac{number\ of\ passed\ hours}{number\ of\ total\ hours}\right) * SP\ of\ last\ trading\ day$$

7. Legal issues

7.1. Protection of the settlement price

The settlement price manual is to be protected by copyright.

7.2. Publication

Settlement price related information (settlement price values, composition of settlement price, calculation parameters, decisions, releases, etc.) are published via the website of the HUDEX (www.hudex.hu).

7.3. Utilization of settlement price

Utilization of settlement price – in accordance with the relevant legislation – is primarily subject to the laws on copyright protection. Use of the settlement price by service providers within the framework of products is subject to the conclusion of a license agreement.