

# D2X Kaiko Digital Assets Rates

## CONTENT

<b>INTRODUCTION</b>	<b>4</b>
<b>REVIEW CALENDAR</b>	<b>5</b>
Scheduled Review and Rebalancing	5
Extraordinary Review	6
<b>METHODOLOGY</b>	<b>7</b>
Data Source	7
Exchange Selection Model	7
Asset-agnostic Vetting	8
Asset-specific Vetting	8
Liquidity	8
Additional Liquidity Layer	8
Minimum Exchanges Number	9
Further Optimization	9
Individual Exchange Analysis	9
Combinations Analysis And Ranking	9
Publication Events	10
Buffer Rules	10
Dynamic Windowing	10
Combination Buffering	10
Dual Buffering	11
Summary	11
Threshold Levels	11
Methodology	11
Rates Calculation	13
Step-by-step Methodology	13
Inputs	13
Volume Weighted Median	14
Fixing Price	14
Partitioning Scheme	15
Data Rounding	15
Blockchain Forks	15
Data Gaps	15
Missing Data	15
Delayed Data	15
Spurious Data	16

Version	Publication date	Comments
1	15/01/2024	Created
2	18/03/2025	Updated to reflect new coverage.

# INTRODUCTION

The following document covers the methodology of the D2X Kaiko Digital Assets Rates - (together, the “D2X Kaiko Rates”). Designed to bring greater transparency to pricing, the D2X Kaiko Rates are solely based on executed trades from centralised exchanges.

D2X, a regulated derivatives exchange, utilizes custom reference rates developed by Kaiko for the settlement of its Bitcoin (BTC) and Ether (ETH) futures contracts. These rates, as listed below, are designed to provide accurate and reliable benchmarks for futures settlement.

The D2X Kaiko Rates are calculated using executed trade data from a curated list of centralized exchanges. This methodology ensures that the rates reflect fair and trustworthy prices, suitable for futures settlement.

**Calculation and dissemination:** The D2X Kaiko Rates are calculated in real-time (every 5 seconds), as well as being published daily at 16:00 London time.

The list of all rates can be found here:

Rate	Kaiko Symbol	ISIN
D2X Kaiko BTC-EUR Reference Rate	D2X-KAIKO_BTCEUR	FR001400JV99
D2X Kaiko BTC-EUR Reference Rate LDN	D2X-KAIKO_BTCEUR_LDNLF	FR001400JVA6
D2X Kaiko ETH-EUR Reference Rate	D2X-KAIKO_ETHEUR	FR001400JVB4
D2X Kaiko ETH-EUR Reference Rate LDN	D2X-KAIKO_ETHEUR_LDNLF	FR001400JVC2
D2X Kaiko BTC-USD Reference Rate	D2X-KAIKO_BTCUSD	FR001400YRG0
D2X Kaiko BTC-USD Reference Rate LDN	D2X-KAIKO_BTCUSD_LDNLF	FR001400YRH8
D2X Kaiko ETH-USD Reference Rate	D2X-KAIKO_ETHUSD	FR001400YRI6
D2X Kaiko ETH-USD Reference Rate LDN	D2X-KAIKO_ETHUSD_LDNLF	FR001400YRJ4

The index is administered by Kaiko Indices, which is responsible for maintaining the integrity, accuracy, and transparency of the index. The administrator ensures compliance with the methodology outlined in this rulebook and oversees any necessary adjustments or updates to the index.

A dedicated Oversight Committee oversees the index methodology, rule changes, and overall governance. The committee is composed of industry experts and representatives from the index provider. Its responsibilities include:

- Ensuring adherence to the stated methodology.
- Reviewing and approving changes to index rules.
- Addressing exceptional market events that may impact the index.
- Providing transparency and accountability in index oversight.

# REVIEW CALENDAR

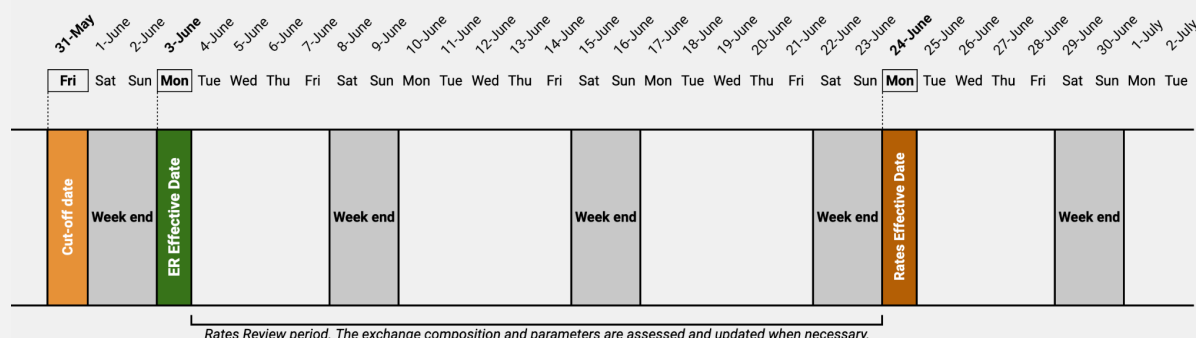
## Scheduled Review and Rebalancing

Rebalancing is a scheduled, regular process designed to ensure that the D2X Kaiko Rates are composed of the most relevant price data feeds and comply with the methodology detailed in this document, including initial vetting, liquidity and optimization requirements (in particular please refer to the Exchange Selection Model section).

All D2X Kaiko Rates will follow the same quarterly rebalancing calendar (March, June, September and December) with cut-off and effective dates structuring the data collection and processing periods followed by publication periods (the calendar dates and weekdays do not account for any holidays).

Event	Date	Description	Example with June 2024 rebalancing
<b>Cut-off Date</b>	Last day of the month preceding the Rebalancing Month.	Data collection for composition determination stops on that day.*	31st of May, 2024
<b>ER Effective Date</b>	First business day of the Review Month	Publication of the new version of the exchange ranking	3rd of June, 2024
<b>Effective Date</b>	Monday after the third Friday of the Rebalancing Month. Usually between 20:00 and 23:00 UTC.	The new exchange composition becomes effective in the calculation of the rates.	24th of June, 2024

\*For instance, if a 3-month Average Daily Traded Volume must be calculated, the covered period will start 3 months before the cut-off date and end on the cut-off date (including the cut-off date, up to UTC 00:00).



Rates Review period. The exchange composition and parameters are assessed and updated when necessary.

## Extraordinary Review

Changes to the index methodology, including revisions to eligibility criteria, weighting, or calculation methodology, follow a structured consultation process:

1. **Proposal Stage** – A proposed rule change is drafted by the index administrator.
2. **Review and Analysis** – The Oversight Committee evaluates the impact of the proposed change.
3. **Public Consultation** (if applicable) – Stakeholders, including market participants and index users, may be consulted.
4. **Final Approval** – The Governance Committee makes a final decision based on feedback and analysis.
5. **Implementation** – Changes are communicated in advance and implemented within a predefined timeframe.

On the basis of its qualified and expert judgement, Kaiko, in consultation with D2X and other relevant stakeholders, reserves the right to exclude or replace an exchange selected during the Scheduled Review, or to suggest and consult on any methodology change that Kaiko considers necessary to ensure the D2X Kaiko Rates continue to reflect the target underlying economic reality. Such a consultation could occur if an exchange has been found to experience an exclusion action, including but not limited to:

- Fraud
- Market manipulation
- Significant loss of volume or liquidity

In such cases, the Kaiko Index Oversight Committee will publish a consultation document explaining its findings and any suggested methodology change. The document will outline a clear timetable for the consultation, including the proposed notice period before any change is implemented. Additionally, any expert judgment exercised by Kaiko Indices leadership must be reviewed by the Oversight Committee within 72 hours to ensure transparency, accountability, and alignment with the index's governance framework.

## Extraordinary Circumstances

In cases of extraordinary market conditions or technical failures, the Oversight Committee has the authority to:

- Temporarily suspend the index calculation if market disruptions severely impact accuracy.

- Implement emergency rule adjustments to maintain index integrity.
- Notify stakeholders promptly about any decisions made under exceptional circumstances.

All governance processes aim to maintain the reliability, accuracy, and transparency of the index, ensuring it serves as a robust benchmark for market participants.



# METHODOLOGY

D2X Kaiko Rates emphasize data quality. Before any rate can be computed, each eligible exchange is screened for both quantitative and qualitative aspects. Said screenings compose a key element to ensure the reliability and authenticity of each and every rate.

## Data Source

The D2X Kaiko Rates levels are based on the tick-by-tick trade data provided by Kaiko.

Kaiko is the leading source of cryptocurrency market data, providing businesses with industrial-grade and regulatory-compliant data. Kaiko empowers market participants with global connectivity to real-time and historical data feeds across the world's leading centralized and decentralized cryptocurrency exchanges. Kaiko's proprietary products are built to empower financial institutions and cryptocurrency businesses with solutions ranging from portfolio valuation to strategy backtesting, performance reporting, charting, analysis, indices, pre and post-trade.

## Exchange Selection Model

Markets in crypto assets are by nature highly fragmented, with hundreds of exchanges spread over different geographical areas, each with their own regulatory framework. Each exchange operates independently, and as such, official statistics and research data are often not publicly available.

As a global digital asset market data provider, Kaiko covers more than a hundred cryptocurrency exchanges. However, not all exchanges offer the same level of standards in terms of legal and compliance, infrastructure security, liquidity, data quality or even technology. The Exchange Selection Model leverages specific parameters of Kaiko Exchange Ranking to make sure only high-quality data are incorporated in the computation of each rate. The Exchange Selection Model is implemented at each quarterly review.

For the purpose of the D2X Kaiko Rates computation, only centralized spot exchanges are considered.

## 1. Asset-agnostic Vetting

Asset-agnostic vetting is based on [Kaiko Exchange Ranking](#) parameters. The Kaiko team conducts the Exchange Ranking assessment quarterly and has it approved by the Kaiko Exchange Ranking Steering Committee.

Criteria	
Absent from any sanction list	Yes
Has been operating for the past	5 Years
Located in a stable and open country	Yes
Regulated by an independent government body	Yes
KYC/AML controls	Strong
Trading Policies	Significant
Offers REST API & WebSocket data feeds	Yes
Offers live & historical trade data	Yes
Provide cold storage for customers funds	Yes

All exchanges that meet the criteria outlined in the table above constitute the initial Kaiko Vetted Exchanges List (KVEL) for the respective rate. During each review cycle, the KVEL will be updated in alignment with the corresponding version of the Exchange Ranking. As the exchange ranking history commenced in January 2022, all rebalancing periods for Kaiko rates prior to this date are linked to the January 2022 Exchange Ranking Review. Subsequent quarterly exchange selections from January 2022 onward are aligned with their respective quarterly Exchange Ranking Reviews.

## 2. Asset-specific Vetting

### Liquidity

The 3-month volume history of the relevant pair (e.g. BTC/USD) is extracted for each exchange and, for each month, an average daily trading volume as a percent of the total average trading volume from the initial KVEL is computed. The monthly average values are in turn averaged, and all exchanges whose average liquidity is strictly below 1% are not considered relevant in terms of liquidity and thus are excluded from the KVEL.

### Additional Liquidity Layer

When the list of exchanges following the liquidity and market quality assessment is above 10 exchanges, we apply a limitation layer that selects only the 10 most liquid

exchanges in terms of contribution to the global volume for a specific asset during the relevant period.

#### Minimum Exchanges Number

For an asset pair to be eligible for rate computation, at least 3 exchanges passing all criteria mentioned above needs to trade the asset pair.

### 3. Further Optimization

#### Individual Exchange Analysis

From the KVEL after asset-specific vetting, further optimization is computed based on the number of zero-volume buckets of the relevant pair in each rolling window during the period. A zero-volume bucket is defined as a timestamp for which no trades in the relevant pair are observed during the rolling window considered. Thus, the aim behind this step is to individually analyse exchanges and classify them based on the number of zero-volume buckets compared to the level of liquidity. This optimization step completes the following combination analysis when deciding between two similar combinations in terms of minimum coverage or liquidity.

#### Combinations Analysis And Ranking

This step is dedicated to extracting the final combination of up to 5 exchanges generating the best liquidity: minimum number of zero-volume buckets and average volume per interval. These combinations are ranked according to those parameters. From this step, the list of exchanges that will be considered in the calculation of the rate is finalised. Note, in order to mitigate turnover in exchanges, a buffer rule (as described in section [Buffer Rules](#)) is applied to all D2X Kaiko rates.

## Publication Events

The D2X Kaiko Rates are published on a real time and daily basis and use a dynamic calculation window:

Rate	Publication Interval
D2X Kaiko BTC-EUR Reference Rate	5 seconds
D2X Kaiko BTC-EUR Reference Rate LDN	Daily - 16:00 London time
D2X Kaiko ETH-EUR Reference Rate	5 seconds
D2X Kaiko ETH-EUR Reference Rate LDN	Daily - 16:00 London time
D2X Kaiko BTC-USD Reference Rate	5 seconds
D2X Kaiko BTC-USD Reference Rate LDN	Daily - 16:00 London time

D2X Kaiko ETH-USD Reference Rate	5 seconds
D2X Kaiko ETH-USD Reference Rate LDN	Daily - 16:00 London time

## Buffer Rules

### 1. Dynamic Windowing

D2X Kaiko Rates are designed with a dynamic windowing feature which aims at securing a minimum liquidity level depending on the market conditions. In practice, it means that for each rebalancing period, a specific rolling window will be selected from a predefined set of eligible windows according to a liquidity score.

- Real-time set: [15s, 20s, 30s, 60s, 120s, 300s]
- Fixing set: [300s, 600s, 900s, 1200s, 1800s, 3600s]

### 2. Combination Buffering

An additional buffering feature is associated with dynamic windowing to mitigate the exchange turnover in the rebalancing. D2X Kaiko Rates are designed to facilitate the methodology replication and therefore the turnover of exchanges in the combination, from one period to the next one, is controlled. As the windowing might impact the exchange selection and the combinations, both are considered in the implementation of rules.

### 3. Dual Buffering

#### Summary

The D2X Kaiko Rates are built with dual buffering which entails dynamic windowing combined with an optimisation of the combinations. The process enables both a maximisation of the liquidity and the stability of the rate composition. To materialise such method, a specific set of rules has been designed based on threshold levels. If the current combination and rolling window start to underperform or outperform a target threshold, the rules will help to better calibrate the rolling window and the combination of exchanges.

## Threshold Levels

Name	Abbreviation	Value
Target Threshold of Zero Volume	<i>Target_ZV</i>	10%
Buffer current set up	<i>Buffer_C</i>	5%
Upgrade threshold current set up ( <i>Target_ZV - Buffer_C</i> )	<i>Up_C</i>	5%
Downgrade threshold current set up ( <i>Target_ZV + Buffer_C</i> )	<i>Down_C</i>	15%
Buffer next set up	<i>Buffer_N</i>	2.5%
Upgrade threshold next set up ( <i>Target_ZV - Buffer_N</i> )	<i>Up_N</i>	7.5%
Upgrade threshold next set up ( <i>Target_ZV + Buffer_N</i> )	<i>Down_N</i>	12.5%

## Methodology

### Historical window and combination

- The initial rolling window is defined as the smallest from the eligible set of windows. The percentage of zero-volume bucket over the past three months is calculated along with all the possible combinations from the KEVL.
- If any of the exchange combinations shows less than 10% zero-volume bucket, the current window size is defined as the first window. If not, the next smallest window is selected, and so on until the condition is met.
- If there are more than one exchanges combinations with less than 10% of zero-volume bucket, choose the combination with the highest trading volume.

### Quarterly review

The quarterly rebalancing relies on a performance assessment of the current setup based on the percentage of zero-volume buckets. However, for the stability of the exchange combination and window size, buffering rules are applied in the following order:

- **Number of exchanges in the current combination**
  - If the number of exchanges in the current combination is less than 5, the combination will be changed based on the new vetted exchanges for the pair.
  - If the number of exchanges in the combination is equal to or above 5, the optimization step is applied as for the first window and

combination: checking percentage of zero-volume bucket and trading volume.

- **Rolling window size**

The percentage of zero-volume bucket with current rolling window size is calculated:

- If it is between the upgrade threshold of the current setup ( $Up_C$ ) and the downgrade threshold for the current setup ( $Down_C$ ), no change will be made in rolling window size and exchanges.
- If the percentage of zero-volume bucket is lower than the upgrade threshold of the current setup ( $Up_C$ ), the rate might be subject to a decrease of the rolling window to increase the market sensibility. The percentage of zero-volume bucket with the next smaller window is computed. If it is below the upgrade threshold for the next setup ( $Up_N$ ) for two consecutive quarters, the rolling window will be decreased to the next smaller.
- If the percentage of zero-volume bucket is higher than the downgrade threshold of the current setup ( $Down_C$ ), the rate might be subject to an increase of the rolling window to capture more liquidity. The percentage of zero-volume bucket with the next larger window is computed. If it is above the downgrade threshold for next setup ( $Down_N$ ) for two consecutive quarters, the rolling window will be increased to the next larger.
- If the percentage of zero-volume bucket is higher than the downgrade threshold of the current setup ( $Down_C$ ) and that of next bigger window is higher than the downgrade threshold for the next setup ( $Down_N$ ), a change in the combination should be considered. The percentage of zero-volume buckets of all the possible combinations of vetted exchanges is calculated.
  - If any of the combinations show less than the downgrade threshold for the next setup ( $Down_N$ ) of zero-volume bucket with current calculation window, the combination is changed.
  - if not, the current combination is maintained and the rolling window is increased if the percentage of zero-volume bucket is higher than the downgrade threshold of the current setup ( $Down_C$ ) next quarter.

## Rates Calculation

The aggregation methodology consists of splitting the calculation period considered into equal size partitions and, for each of them, extracting the most representative trade whose price will be used for the final rate calculation.

All trades in the relevant pair from the relevant exchanges are pooled together and grouped into relevant time partitions. For each partition, the most representative trade is defined as the volume median one.

## 1. Step-by-step Methodology

- At calculation time (end of each publication interval for real-time, and at set times for daily fixings), collect all executed trades in the calculation window (before the calculation time) on all selected exchanges.
- Merge all the executed trades from the different exchanges in the same dataset sorted by prices in ascending order.
- Create  $K$  partitions of  $S_{part}$  size from the calculation window (eg. 1h calc. window with 10 partitions of 6 min).
- Each partition is then subject to a Volume Weighted Median (outlier resistant by nature). A detailed description of this aggregation method is provided below.
- A time weight is associated with each partition's volume-weighted median (more weights to the last partitions which are the most recent).
- Aggregation of those weighted prices (eg. 10 prices aggregated on 1h calc. window) to obtain the reference price for this publication event.

## 2. Inputs

Symbol	Name	Description
$t$	Event	The timestamp at which the fixing price ( $FP$ ) is calculated.
$S_{wind}$	Calculation Window Size	Size of the calculation period for which trades are collected and aggregated.
$S_{part}$	Partition Size	Size of each partition in the calculation window.
$K$	Number of Partitions	The number of partitions is an integer calculated as $S_{wind}/S_{part}$ .
$k$	Partition Number	$k_{th}$ partition.
$I_k$	Partition Trade Distribution	List of trades included in partition $k$ and ordered by ascending price.
$p_i^k$	Partition Trade Price	$i^{th}$ trade price in the $k_{th}$ partition (price-ordered distribution).
$v_i^k$	Partition Trade Volume	$i^{th}$ trade volume in the $k_{th}$ partition (price-ordered

		distribution).
$VWM_k$	Volume-Weighted Median	Volume-weighted median of the $k_{th}$ partition.
$WP_t$	Window Price	Window price ( $WP$ ) at time $t$ .

### 3. Volume Weighted Median

The volume-weighted median ( $VWM_k$ ) is calculated as the price ( $p_j^k$ ) of the  $j^{th}$  trade where the  $j^{th}$  trade is the trade that lies at 50% of the cumulative volume for the partition  $k$ .  $VWM_k$  is calculated for each partition in  $S_{wind}$ :

$$VWM_k = p_j^k \text{ where } j \text{ satisfies } \sum_{i=0}^{j-1} v_i^k < \frac{\sum_{i=1}^{I_k} v_i^k}{2} \text{ and } \sum_{i=j+1}^{I_k} v_i^k \leq \frac{\sum_{i=1}^{I_k} v_i^k}{2}$$

$$\text{If } \exists j : v_j^k > \frac{\sum_{i=1}^{I_k} v_i^k}{2} \text{ then } VWM_k = p_j^k$$

$$\text{If } \exists j : \sum_{i=j+1}^{I_k} v_i^k = \frac{\sum_{i=1}^{I_k} v_i^k}{2} \text{ then } VWM_k = \frac{p_j^k + p_{j+1}^k}{2}$$

### 4. Fixing Price

The Fixing Price ( $FP$ ) is calculated as a time weighted average price (TWAP) of all the  $VWM_k$  of all the  $K$  partitions. We implement a sensitivity calibration method on partitions to increase the weight of the most recent prices included in the calculation window.

First, we apply a specific weighting function to obtain weights that are inversely proportional to time  $t$ . It gives:

$$w_k = \frac{1}{K} \sum_{j=1}^k 1_{j \leq k}$$

The weights are then normalised:

$$\overline{w}_k = \frac{w_k}{\sum_j w_j}$$

Thus, the fixing price is equal to:



$$FP_T = \sum_{k=1}^K (VWM_k \times \overline{w_k})$$

## 5. Partitioning Scheme

Each rate breaks down the window size into n partitions of equal size. Here is a summary of all the window size/partitions number combinations:

- Real-time set: [15s/5p, 20s/10p, 30s/10p, 60s/10p, 120s/10p, 300s/10p]
- Fixing set: [300s/10p, 600s/10p, 900s/10p, 1200s/10p, 1800s/10p, 3600s/10p]

## 6. Data Rounding

All rates are calculated with all available decimals but published with two decimals.

## 7. Blockchain Forks

In the event of a fork of the blockchain, the ticker used on each constituent exchange may be adjusted to represent the relevant instrument. In the event of a fork of the blockchain, the Index Administration Committee (IAC) will determine if the new asset pair is significant and whether any adjustments are to be made with respect to the affected rate. Such a decision will be publicly announced prior to implementation.

## 8. Data Gaps

### Missing Data

At the time of the calculation ( $t$ ), some relevant transactions may be missing for an array of reasons. If no relevant transactions are recorded on the relevant partition, the corresponding partition is excluded from the calculation and weights are adjusted accordingly. If no relevant transactions are recorded in the entire calculation window, the price is not published.

### Delayed Data

If for any reason Kaiko was unable to retrieve any relevant transactions at the calculation time, the corresponding partition is excluded from the calculation.

### Spurious Data

If for any reason any transactions were identified as potentially suspect within a partition, such transactions may be adjusted to disregard the spurious data.