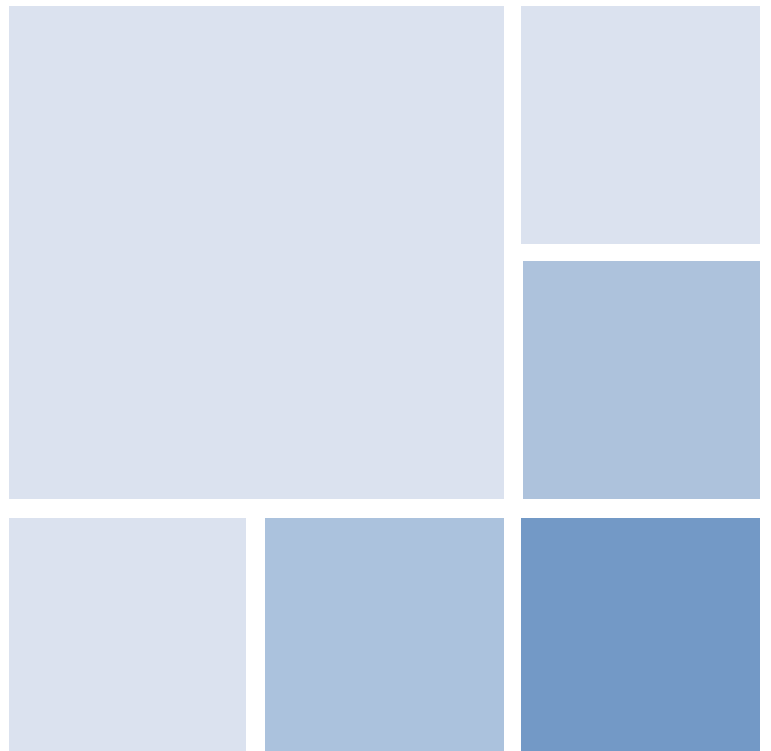


# Goldman Sachs ActiveBeta® Paris-Aligned Equity Indexes Methodology

Last updated 25 February 2022



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## I. Introduction

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### A. Index Overview

This document describes the methodology for the following indexes:

- Goldman Sachs ActiveBeta® Paris-Aligned Europe Equity Index
- Goldman Sachs ActiveBeta® Paris-Aligned U.S. Large Cap Equity Index
- Goldman Sachs ActiveBeta® Paris-Aligned Emerging Markets Equity Index

The Goldman Sachs ActiveBeta® Equity Indexes are owned by Goldman Sachs Asset Management (the Index Sponsor) and have been developed to capture the performance of diversified exposure to four common equity factors: value, momentum, volatility, and quality. The indexes aim to meet the minimum requirements to be an EU Paris Aligned Benchmark in accordance with Articles 3 (1) (23b) and 19a (1) and Annex III of the Regulation (EU) 2016/1011 (as amended) and the European Commission Delegated Regulation (EU) 2020/1818. The Index Sponsor has appointed Solactive AG (the Index Administrator) to assume the role as administrator under the Regulation (EU) 2016/1011 (the Benchmark Regulation or BMR).

Using a patented portfolio construction methodology and patent-pending turnover minimization technique, each Index aims to deliver higher returns over a full investment cycle than its Parent Index – a market capitalization-weighted index for the same geographical region (defined below) – at similar or lower levels of total risk, as measured by volatility. Through diversified exposure to common equity factors, the Goldman Sachs ActiveBeta® Equity Indexes also seek to mitigate the magnitude and duration of potential market underperformance compared to strategies that provide exposure to a single common equity factor.

Each index aims to exclude issuers engaged in carbon-intensive activities and select other controversial activities; to achieve a reduction in Greenhouse Gas (GHG) emission intensity of 50 percent relative to its Parent Index; to achieve an inflation-adjusted reduction in absolute emissions intensity of seven percent annually; and to achieve exposure to high carbon impact sectors equal to or greater than the Parent Index. Emissions intensity is equal to the sum of scope 1 (direct), scope 2 (indirect upstream from purchased utilities), and scope 3 (other indirect upstream and all downstream) emissions divided by enterprise value including cash.

## B. Index Details

The Goldman Sachs ActiveBeta® Equity Indexes are distributed under the following identifiers.

Name	Ticker
Goldman Sachs ActiveBeta® Paris-Aligned Europe Equity Index (PR, EUR)	GAEUPR
Goldman Sachs ActiveBeta® Paris-Aligned Europe Equity Index (TR, EUR)	GAEUTR
Goldman Sachs ActiveBeta® Paris-Aligned Europe Equity Index (NR, EUR)	GAEUNR
Goldman Sachs ActiveBeta® Paris-Aligned U.S. Large Cap Equity Index (PR, USD)	GAUSPR
Goldman Sachs ActiveBeta® Paris-Aligned U.S. Large Cap Equity Index (TR, USD)	GAUSTR
Goldman Sachs ActiveBeta® Paris-Aligned U.S. Large Cap Equity Index (NR, USD)	GAUSNR
Goldman Sachs ActiveBeta® Paris-Aligned Emerging Markets Equity Index (PR, USD)	GAEMPR
Goldman Sachs ActiveBeta® Paris-Aligned Emerging Markets Equity Index (TR, USD)	GAEMTR
Goldman Sachs ActiveBeta® Paris-Aligned Emerging Markets Equity Index (NR, USD)	GAEMNR

## II. Index Construction Methodology

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### A. Eligible Securities

The eligible securities for each of the Goldman Sachs ActiveBeta® Indexes are defined as the constituents of the following Parent Indexes.

<b>Goldman Sachs ActiveBeta® Paris-Aligned Equity Index</b>	<b>Parent Index</b>
Europe	MSCI Europe Standard Index
US Large Cap	Solactive US Large Cap Index
Emerging Markets	MSCI Emerging Markets Standard Index

Further, the eligible securities exclude the stock of Goldman Sachs and any stocks that are traded solely on the Shenzhen or Shanghai exchanges.

More information about the MSCI Indexes is available from <http://www.msci.com/>, and the Solactive Index from [www.solactive.com](http://www.solactive.com).

### B. Index Construction

The Index Construction Methodology for each ActiveBeta® Paris-Aligned Equity Index comprises three steps (as described in more detail below):

1. Create the Post-Exclusion Parent Index by excluding securities from the universe of eligible securities per the minimum requirements to be an EU Paris Aligned Benchmark.
2. Create the Factor Diversity Portfolio by reweighting the securities in the Post-Exclusion Parent Index to obtain exposure to four common equity factors: value, momentum, quality, and low volatility.
3. Create the ActiveBeta® Paris-Aligned Equity Index by adjusting the weights of the securities in the Factor Diversity Portfolio to reduce emission intensity by 50 percent relative to the Parent Index and by 7 percent annually (inflation-adjusted) while maintaining non-negative aggregate exposure to high carbon impact sectors compared to the Parent Index and the same or higher exposure to the four common equity factors compared to the Factor Diversity Portfolio.

As referred to below, the Selection Date is the date on which the exclusion metrics, factor scores, emission intensity, and exposures to high carbon impact sectors and common equity factors are measured. The Selection Date is eight US trading days prior to the Rebalance Date for the ActiveBeta® Paris-Aligned Equity Europe Index and the ActiveBeta® Paris-Aligned Equity Emerging Markets Index. The Selection Date is seven US trading days prior to the Rebalance Date for the ActiveBeta® Paris-Aligned Equity US Large Cap Index.

## 1. EU Paris Aligned Benchmark Exclusions

The Post-Exclusion Parent Index is obtained by excluding securities that meet the following criteria from the universe of eligible securities:

- Coal: Exploration, mining, extraction, distribution, or refining of hard coal and lignite (one percent or more of revenue)
- Oil: Exploration, extraction, distribution, or refining of oil fuels (10 percent or more of revenue)
- Gas: Exploration, extraction, manufacturing, or distribution of gaseous fuels (50 percent or more of revenue)
- Electric power: Electricity generation with a GHG intensity of more than 100g CO<sub>2</sub>e/kWh (50 percent or more of revenue)
- Environmental objectives: Fossil Fuel activities (more than 50 percent of revenue) or activities that significantly obstruct the United Nations Sustainable Development Goals that correspond to the EU's six environmental objectives.
- Controversial weapons: Any involvement with biological weapons, chemical weapons, nuclear weapons, depleted uranium, cluster munitions, or anti-personnel mines
- Tobacco: Any involvement in the cultivation or production of tobacco products
- Global norms: Violation of the United Nations Global Compact principles or the OECD Guidelines for Multinational Enterprises

## 2. Exposure to Value, Momentum, Quality, and Low Volatility

First, four separate ActiveBeta<sup>®</sup> factor subindexes are constructed from the Post-Exclusion Parent Index using a patented portfolio construction methodology.<sup>1</sup> Next, the four subindexes are combined to form the Factor Diversity Portfolio.

### 2.0 Assigning factor scores

For each ActiveBeta<sup>®</sup> factor subindex, constituents in the Post-Exclusion Parent Index are ranked on the basis of the corresponding factor.

Each factor is calculated as follows:

- **Value** – A composite of book value-to-price, sales-to-price, and free cash flow-to-price. The earnings-to-price ratio is used in place of the free cash flow-to-price ratio for commercial banks, diversified financials, and insurance companies or if free cash flow is not available.

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<sup>1</sup> Methods and Systems for Building and Maintaining Portfolios based on Ordinal Ranks of Securities, U.S. Patent Numbers 8,285,620 and 8,473,398.

- **Momentum** – Beta- and volatility-adjusted daily total returns over an 11-month period ending one month before the Rebalance Date.
- **Quality** – Gross profit divided by total assets, or return on equity for commercial banks, diversified financials, and insurance companies or if gross profit is not available.
- **Low Volatility** – The inverse of the standard deviation of daily total stock returns over the past 12 months, up to and including the Selection Date.

Sales, free cash flow, earnings, and gross profits are annual figures.

The factors are used to rank the stocks. Ranks are converted to fractional scores ranging from – 1 to +1, inclusive.

## 2.1 Cut-off Score and Maximum Stock Underweight

Two parameters are used in the construction process for each ActiveBeta® factor subindex:

- Cut-off Score
- Maximum Stock Underweight

The Cut-off Score determines the proportion of underweights to overweights in each factor subindex, and the Maximum Stock Underweight determines the magnitude of stock weight differences (underweights and overweights) relative to their weights in the Post-Exclusion Parent Index.

The appropriate parameter values for each factor subindex are determined based on historical simulations and are fixed for each ActiveBeta® Paris-Aligned Index.

## 2.2 Determining target underweights and overweights

Stocks with factor scores above the Cut-off Score are over weighted relative to the Post-Exclusion Parent Index, and stocks with factor scores below the Cut-off Score are underweighted.

Each factor subindex is subject to a long-only constraint; hence, the smallest weight of any stock is zero.

For all stocks and for each factor:

- For stocks with factor scores less than the Cut-off Score, rescale the factor scores to range uniformly from –1 to 0

- For stocks with factor scores greater than or equal to the Cut-off Score, rescale the factor scores to range uniformly from 0 to +1

Once the factor scores are rescaled, stocks with factor scores greater than 0 are over weighted relative to the Post-Exclusion Parent Index. Stocks with factor scores less than or equal to 0 are underweighted relative to the Post-Exclusion Parent Index.

For the ActiveBeta® Low Volatility subindex only, stocks in the Post-Exclusion Parent Index are reweighted using ½ equal weights and ½ index weights within sectors, countries, and/or regions before calculating the overweights and underweights.

For all stocks and factors with  $RScore_i \leq 0$ ,

$$TgtWgt_i = \max (IUWgt_i + RScore_i \times MaxUnderWgt, 0)$$

The total of the stock underweights across stocks is calculated.

$$TotalUnderWgt = \sum ( IUWgt_i - TgtWgt_i )$$

For all stocks and factors with  $RScore_i > 0$ ,  $TgtWgt_i'$  is determined by proportionately reweighting all constituents such that the sum of the underweights is equal to the sum of the overweights

$$( TotalUnderWgt = TotalOverWgt )$$

$$TgtWgt_i' = IUWgt_i + RScore_i / \sum RScore_i \times TotalUnderWgt$$

where the summation is over all stocks with  $RScore_i > 0$ .

Any  $TgtWgt_i'$  that exceeds 20 times  $IUWgt_i$  is capped at 20 times  $IUWgt_i$ .

Definitions:

$RScore_i$  = rescaled factor score for each stock and factor (–1 to 0 for underweights and 0 to +1 for overweights)

$TgtWgt_i$  = the target weight of each stock in its factor subindex prior to any capping or turnover minimization

$IUWgt_i$  = the weight of each stock in its Post-Exclusion Parent Index

$MaxUnderWgt$  = the maximum stock under-weight that applies for each factor subindex

$TotalUnderWgt$  = the sum of all the stock underweights in a factor subindex relative to its Parent Index



$TgtWgt_i'$  = the target weight of each stock in its factor subindex prior to any capping or turnover minimization, normalized to ensure that  $TotalUnderWgt = TotalOverWgt$

### 2.3 Controlling country, region, and industry group exposures

The exposures to countries, regions, and industry groups of each factor subportfolio relative to its Post-Exclusion Parent Index are constrained as follows:

- **Value** – Industry group weights within each geographic region are constrained to be within +/- 1% of those of the same region in the Post-Exclusion Parent Index. Overall weight constraints apply to the exposure of major regions.
- **Momentum** – All country weights are constrained to be within +/-  $\max(1\%, 5\% \times \frac{\sqrt{\# \text{ stocks in each Country}}}{\text{Max}(\sqrt{\# \text{ stocks in a Country}})})$  of the country weights for the Post-Exclusion Parent Index.
- **Quality** – Country weights are constrained to be within +/- 1% of those of the Post-Exclusion Parent Index.
- **Low Volatility** – Country weights are constrained to be within +/- 1% of those of the Post-Exclusion Parent Index.

### 2.4 Combining the ActiveBeta® factor subindexes

Each Goldman Sachs ActiveBeta® Paris-Aligned Equity Index weights equally the four corresponding ActiveBeta® factor subindexes. As part of this combination, offsetting security positions are calculated and netted across the four ActiveBeta® factor subindexes using the ActiveBeta® Turnover Minimization Technique.<sup>2</sup> The ActiveBeta® Turnover Minimization Technique reduces the turnover in the ActiveBeta® Paris-Aligned Equity Indexes by calculating offsetting pair trades in the individual factor subindexes and allowing constituent weights to float inside the upper and lower weight bounds.

A trade weight is calculated for each stock from the difference between the stock's weight before rebalancing and the weight determined by combining the four factor subindexes. The lower and upper trading bounds allow a stock's weight to deviate from its target weight, either positively or negatively, before a trade or rebalancing is triggered. Iterative pair-wise trades are netted until the minimum amount of trading is determined which maintains each stock within its upper and lower weight bounds.

The upper and lower bounds are determined using the following process:

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<sup>2</sup> Methods and Systems for Reducing Turnover in Multi-Portfolio Structures, U.S. Patent Application Number 14/208,865.

- Each stock is assigned its target weight,  $TgtWgt_i^t$  according to the Index Construction Methodology.
- A buffer is assigned to a stock relative to each factor index's maximum underweight.

$$Buffer_i = \min (0.20 \times MaxUnderWgt, 0.30\%)$$

The lower and upper trading bounds on stock  $i$  are then defined as:

$$LowerWgt_i = \min ( \max (TgtWgt_i - Buffer, 0), MaxWgt_i)$$

$$UpperWgt_i = \min ( \max (TgtWgt_i + Buffer, 0), MaxWgt_i)$$

where

$TgtWgt_i^t$  = the target weight of each stock in its factor subindex prior to any capping or turnover minimization, normalized to ensure that TotalUnderWgt = TotalOverWgt

$MaxUnderWgt$  = the maximum stock under-weight that applies for each factor subindex

$$MaxWgt = 20 \times IUWgt_i$$

$IUWgt_i$  = the weight of each stock in its Parent Index

### 3. Reduction in emission intensity

To create each ActiveBeta® Paris-Aligned Equity Index, a quadratic optimiser is used to adjust the weights in the Factor Diversity Portfolio to satisfy the following conditions on the Selection Date:

- A reduction in emission intensity of 50 percent relative to the emission intensity of the Parent Index. A stock's emission intensity is equal to the sum of scope 1, scope 2, and scope 3 emissions (in units of tonnes of CO<sub>2</sub>e) scaled by enterprise value including cash, where enterprise value is the sum of the market value of common equity, the market value of preferred stock, the book value of short- and long-term debt, and the book value of minority interest.
- Seven percent annual decarbonisation, which corresponds to a reduction in emission intensity of seven percent relative to the emission intensity of the ActiveBeta® Paris-Aligned Equity Index one year ago. The emissions intensity is adjusted for inflation in enterprise value using the ratio of the average enterprise value for the Parent Index as of the most recent calendar year end to the average enterprise value of the Parent Index as of the previous calendar year end. Because the indexes are rebalanced quarterly, the seven-percent inflation-adjusted annual reduction in emission intensity is achieved via quarterly reductions of approximately 1.8 percent, the geometric quarterly mean of the annual target.

- Aggregate exposure to high impact sectors greater than or equal to the aggregate exposure to high impact sectors for the Parent Index, where high impact sectors include agriculture, forestry, and fishing; mining and quarrying; manufacturing; electricity, gas, steam, and air conditioning supply; water supply, sewerage, waste management and remediation activities; construction; wholesale and retail trade, repair of motor vehicles and motorcycles; transportation and storage; real estate activities.
- Exposure to each ActiveBeta® factor (value, momentum, quality, and low volatility) that is greater than or equal to the exposure to the factor in the Factor Diversity Portfolio.

The final weights must be non-negative.

The quadratic optimizer minimizes the sum of squared deviations between each ActiveBeta® Paris-Aligned Equity Index and the corresponding Factor Diversity Portfolio, subject to the four conditions above. If the optimizer is not able to satisfy the four conditions, the optimizer will relax the condition regarding the exposures to the four ActiveBeta® factors by reducing the minimum exposure constraint by 0.01 for each of the four factors until these constraints are no longer binding.

Three final constraints are applied across each ActiveBeta® Paris-Aligned Equity Index such that 1) the weight of any single issuer shall not exceed 10%, 2) the sum of all stock positions with a weight greater than 5% shall not exceed 25% in aggregate, and 3) the weight of each industry group shall be less than 25%.

### III. Index Rebalancing

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#### A. Rebalancing Schedule

In order to reflect the new selection of the index components determined on the Selection Date the Index is adjusted on the Rebalance Date after close of business.

The ActiveBeta® Paris-Aligned Europe Equity Index and the ActiveBeta® Emerging Market Paris-Aligned Equity Index are rebalanced quarterly according to the published rebalancing schedule of their Parent Indexes, typically on the close of the last business day of February, May, August, and November.

The ActiveBeta® Paris-Aligned U.S. Large Cap Equity Index is rebalanced quarterly according to the published rebalancing schedule of its Parent Index, on the close of the first Wednesday of February, May, August, and November or, if that day is a US exchange holiday, the next trading day.

This is carried out by implementing the shares as determined on the Selection Date based on the weights calculated on the same Selection Date.

For more information on the rebalance procedure please refer to the Equity Index Methodology, which is incorporated by reference and available on the Solactive website:  
<https://www.solactive.com/documents/equity-index-methodology/>.

## IV. Index Calculation and On-going Maintenance

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### A. Daily Calculation

The indexes are calculated by the Index Administrator.

The Index Administrator is responsible for calculating index levels based on inputs provided by the Index Sponsor on a quarterly basis. The Index Administrator applies corporate action adjustments and calculates the indexes as described in the Solactive Equity Index Methodology, Version 1.6 dated 20 July 2021 <https://www.solactive.com/documents/equity-index-methodology/>. The Solactive Equity Index Methodology may be amended from time to time in accordance with the process described in the Solactive Methodology Policy <https://www.solactive.com/documents/methodology-policy/>.

Price, net and gross total return indexes are calculated for each ActiveBeta® Paris-Aligned Equity Index. Gross total return indexes assume reinvestment of gross cash dividends across the full index at the open on the ex-date. The net total return indexes are calculated using net dividends.

The compositions of the ActiveBeta® Paris-Aligned Equity Indexes are available on the GSAM website ([www.gsamfunds.com](http://www.gsamfunds.com)) and Solactive website ([www.solactive.com](http://www.solactive.com)) on a daily basis. Results of the latest rebalancing are available on the Solactive website three US trading days prior to the effective date ([www.solactive.com](http://www.solactive.com)) and are adjusted for corporate actions between the Selection date and Rebalance dates in accordance with the rules for in the Solactive Equity Index Methodology. The Index Administrator will announce index adjustments to account for corporate actions with a notice period of at least two days on the Solactive website <https://www.solactive.com/news/announcements/>. The adjustments will be implemented on the effective day specified in the respective notice.

The Index Administrator makes the greatest possible efforts to accurately calculate and maintain the indexes. However, errors in the determination process may occur from time to time for variety reasons (internal or external) and therefore, cannot be completely ruled out. The Index Administrator endeavors to correct all errors that have been identified within a reasonable period of time. The understanding of “a reasonable period of time” as well as the general measures to be taken are generally depending on the error and the affected stock and are specified in the Solactive Correction Policy <https://www.solactive.com/documents/correction-policy/>.

In periods of market stress Index Administrator calculates the indexes following predefined and exhaustive arrangements as described in the Solactive Disruption Policy <https://www.solactive.com/documents/disruption-policy/>. Such market stress can arise due to a variety of reasons, but generally results in inaccurate or delayed prices for one or more stock in the indexes. The determination of the indexes may be limited or impaired at times of illiquid or fragmented markets and market stress.

## B. Inception Date & Value

The ActiveBeta® Paris-Aligned Equity Indexes have the following inception dates. Index data prior to the inception dates are based on backtests (pre-inception performance).

Name	Date
Goldman Sachs ActiveBeta® Paris-Aligned Europe Equity Indexes	30 November 2021
Goldman Sachs ActiveBeta® Paris-Aligned U.S. Large Cap Equity Indexes	3 November 2021
Goldman Sachs ActiveBeta® Paris Aligned Emerging Markets Equity Indexes	30 November 2021

## V. Amendments and Exceptions to this Methodology

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The application by the Index Sponsor and the Index Administrator of the method for the composition and calculation of the indexes described in this document is final and binding. However, it cannot be excluded that the market environment, supervisory, legal and financial or tax reasons may require changes to be made to this method. The Index Administrator may also make changes to the method applied to calculate the indexes that it deems to be necessary and desirable in order to prevent obvious or demonstrable error or to remedy, correct or supplement incorrect provisions. The Index Administrator is not obliged to provide information on any such modifications or changes – irrespective of possible obligations to the Index Sponsor.

## VI. Methodology Review

The methodology for the Goldman Sachs ActiveBeta® Equity Indexes is subject to regular review, at least annually. In case a need of a change of the methodology has been identified within such review (e.g. if the underlying market or economic reality has changed since the launch of the indexes, i.e. if the present methodology is based on obsolete assumptions and factors and no longer reflects the reality as accurately, reliably and appropriately as before), such change will be made in accordance with the process described in the Solactive Methodology Policy <https://www.solactive.com/documents/methodology-policy/>.

Such change in the methodology will be announced on the Solactive website <https://www.solactive.com/news/announcements/>. The date of the last amendment of this Methodology Document is contained in section VIII.



## VII. Termination

The Index Administrator has established and maintains clear guidelines on how to identify situations in which the cessation of the indexes is unavoidable, how stakeholders are to be informed and consulted and the procedures to be followed for a termination or the transition to an alternative index. Details are specified in the Solactive Termination Policy <https://www.solactive.com/documents/termination-policy/>.

## VIII. Updates to this Methodology Document

02/23/2022 – Updated to include the Goldman Sachs ActiveBeta® Paris-Aligned Europe Equity Indexes and the Goldman Sachs ActiveBeta® Paris-Aligned Emerging Markets Equity Indexes.

## IX. Disclosures

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### **Index Benchmarks**

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