

GUIDELINE

US ESG Minimum Variance Index (GR/NR/PR)

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This document contains the underlying principles and regulations regarding the structure and the operating of the Solactive US Benchmark Index Series ("the Indices"). Solactive AG shall make every effort to implement regulations. Solactive AG does not offer any explicit or tacit guarantee or assurance, neither pertaining to the results from the use of the Indices nor the Index values at any certain point in time nor in any other respect. The Indices are merely calculated and published by Solactive AG and it strives to the best of its ability to ensure the correctness of the calculation. There is no obligation for Solactive AG – irrespective of possible obligations to issuers – to advise third parties, including investors and/or financial intermediaries, of any errors in the Index. The publication of the Index by Solactive AG is no recommendation for capital investment and does not contain any assurance or opinion of Solactive AG regarding a possible investment in a financial instrument based on these Indices.

Introduction

This document is to be used as a guideline with regard to the composition, calculation and management of the US ESG Minimum Variance Index (GR/NR/PR). Any changes made to the guideline are initiated by the Committee specified in section 1.6 of this document. The US ESG Minimum Variance Index (GR/NR/PR) is calculated and published by Solactive AG. The name “Solactive” is copyrighted.

1 Index specifications

The US ESG Minimum Variance Index (GR/NR/PR) is calculated and distributed by Solactive AG.

The aim of the index is to deliver the performance of an ESG best-in-class filtered selection of liquid stocks from the Solactive US Large Cap Index, weighted in such a way to minimize the volatility of the portfolio. The index is adjusted monthly.

The Index is calculated as Price Return, Net Return and Gross Total Return. No withholding tax rate is applied to regular (reinvested in the Gross Total Return Index) and special cash distributions (reinvested into Price Return Index and Gross Total Return Index).

The Indices are published in USD.

1.1 Short name and ISIN

The US ESG Minimum Variance Index (GR/NR/PR) is distributed under the following identifiers:

Name	ISIN	WKN	Characteristic	Reuters	Bloomberg
US ESG Minimum Variance Index GR	DE000SLA1XS5	SLA1XS	Gross Return	.ESGUSMVG	ESGUSMVG Index
US ESG Minimum Variance Index NR	DE000SLA1XR7	SLA1XR	Net Return	.ESGUSMVN	ESGUSMVN Index
US ESG Minimum Variance Index PR	DE000SLA1XQ9	SLA1XQ	Price Return	.ESGUSMVP	ESGUSMVP Index

1.2 Initial value

The Indices are launched with a level of 100 at the close on the start date, December 18th, 2009.

1.3 Distribution

The US ESG Minimum Variance Index (GR/NR/PR) is published via the price marketing services of Boerse Stuttgart AG and is distributed to all affiliated vendors. Each vendor decides on an individual basis as to whether he will distribute/display the US ESG Minimum Variance Index (GR/NR/PR) via his information systems.

1.4 Prices and calculation frequency

The price of the US ESG Minimum Variance Index (GR/NR/PR) is calculated on each Business Day based on the prices on the relevant Primary Exchange in the US on which the Index Components are listed. The most recent prices of all Index Components are used. Should there be no price available on Reuters for any Business Day, the most recent price on Reuters for the preceding Business Day is used in the index calculation.

The US ESG Minimum Variance Index (GR/NR/PR) is calculated every Business Day from 9:30am to 16:30pm, EST. In the event that data cannot be provided to Reuters or to the pricing services of Boerse Stuttgart AG the Index cannot be distributed.

Any incorrect calculation is adjusted on a retrospective basis.

1.5 Decision-making bodies

A Committee composed of staff from Solactive is responsible for decisions regarding the composition of the US ESG Minimum Variance Index (GR/NR/PR) as well as any amendments to the rules (in this document referred to as the “Index Committee”). The future composition of the Indices is determined by the Committee on the Selection Days according to the procedure outlined in 2.1 of this document, applicable to all stocks that meet the criteria outlined in chapter 2 of this document. The Committee shall also decide about the future composition of the US ESG Minimum Variance Index (GR/NR/PR) if any Extraordinary Events occur and the implementation of any necessary adjustments.

Members of the Committee can recommend changes to the guideline and submit them to the Committee for approval.

1.6 Publication

All specifications and information relevant for calculating the Index are made available on the <http://www.solactive.de> web page and sub-pages.

1.7 Historical data

Historical data will be maintained from the launch of the Index on March 9th 2016.

1.8 Licensing

Licences to use the Index as the underlying for investment products issued by stock exchanges, banks, financial services providers and investment houses or for benchmark usage are granted by Solactive AG.

2 Index rebalancing methodology

2.1 Review Schedule

For the purpose of this document, a Business Day means any day for which the US equity market is open. The index composition is reviewed monthly. The Rebalancing Date of the index is the third Friday of the month. If the third Friday of the month is not a Business Day, then the Rebalancing Date shifts forward to the first Business Day after the third Friday. The new index composition is effective at the Effective Date (the first Business Day after the Rebalancing Date). The Estimation Date is K Business Days before the Rebalancing Date. The optimal weights of the new index composition are computed the first Business Day after the Estimation Date (the Calculation Date, i.e. K-1 Business Days before the Rebalancing Date) for implementation after the close of US market on the Rebalancing Date. Parameter K is defined in Section 0

2.2 Reference Universe

The Investment universe of the Index is the forecasted composition of the Solactive US Large Cap Index at the Effective Date. Therefore, it is the current (at the Estimation Date) composition of the Solactive US Large Cap Index to which scheduled Additions and Deletions between the Estimation Date and the Effective Date are applied.

2.3 Work Flow

On each Calculation Date, the review process determines a new investable minimum variance index based on the benchmark composition. The process can be summarized by this workflow:

- a) Base Universe: Selection from the base index.
- b) ESG Universe: Select the most ESG-compliant stocks from the Base Universe.
- c) Liquid Universe: Select the most liquid stocks from the ESG Universe.
- d) Eligible Universe: Filter out stocks with irregularities in price history from the Liquid Universe.
- e) Optimized Portfolio: Weight stocks among the Eligible Universe in order to minimize the total portfolio variance under constraints.
- f) Minimum Variance Portfolio: Filter out stocks with negligible weight within the Optimized Portfolio.

2.4 Data

The following data is used in the Index construction process:

- P - daily share prices at market close in USD,
- TR – daily share total return price. The total return price is adjusted for corporate actions and dividend payments in USD,
- V - daily transaction volume from the US stock exchanges,
- classification of the stocks in Solactive US Large Cap by industrial sector corresponding to the Sustainability Peer Group and the following mapping:

Sector	Peer Group
Energy	Energy Services
	Oil & Gas Producers
	Refiners & Pipelines
Materials	Chemicals
	Construction Materials
	Containers & Packaging
	Diversified Metals
	Paper & Forestry
	Precious Metals
	Steel
Industrial	Aerospace & Defense
	Building Products
	Commercial Services
	Construction & Engineering
	Electrical Equipment
	Industrial Conglomerates
	Machinery
	Traders & Distributors
	Transportation
	Transportation Infrastructure
Cons. Discretionary	Auto Components
	Automobiles
	Consumer Durables
	Consumer Services
	Homebuilders
	Media
	Retailing
Textiles & Apparel	
Cons. Staples	Food Products
	Food Retailers
	Household Products
HealthCare	Healthcare
	Pharmaceuticals
Financials	Banks
	Diversified Financials
	Insurance
	Real Estate
IT	Semiconductors
	Software & Services
	Technology Hardware
Telecommunications	Telecommunication Services
Utilities	Utilities

- Business Date: all trading dates in the US market.
- ESG Score: the Total Score, for each stock in the Base Universe, provided by Sustainalytics
- Involvement in Controversial Weapon (Flag Yes/No), provided by Sustainalytics
- Scores G.1.5., G.2.13, G.3.4, E.1.12, E.2.2, E.3.2, S.1.7, S.2.3, S.3.3, S.4.3, provided by Sustainalytics
- Compliance Status (Flag Yes/No) , provided by Sustainalytics
- Peer Group: sector classification, provided by Sustainalytics

2.5 Determination of the Eligible Universe

2.5.1 Base Universe

The Base Universe is determined as the forward composition of the benchmark index at the Effective Date. The forward composition means the composition adjusted by all reviews (additions/deletions) and corporate actions that will become effective between the current Calculation Date and the current Effective Date.

2.5.2 ESG Universe

The ESG Universe is determined as the result of the following filters:

2.5.2.1 Coverage filter

We consider eligible all stocks in the Base universe which also is covered by Sustainalytics. (i.e. there exist a ESG Score provided by Sustainalytics.). Since ESG score updates and index rebalancings may not be synchronous, we assign the last available score to each stock in the Base Universe.

2.5.2.2 Best-In-Class filter

Each stock that passes the filter 0 in is clustered into its Peer Group. Within each Peer Group, stocks are sorted according their ESG score in decreasing order. Each stock is then assigned a weight equal to $1/N$, where N is the number of stock in the Peer Group. Finally, starting from the stock with the highest ESG score, we select the first k stocks in the Peer Group so that their cumulative weights are equal or higher than $(100-B) \%$. The Best-In-Class eligible selection is then the union, across all Peer Groups, of stocks selected according to the procedure above described. Parameter B is defined in Section 0

2.5.2.3 Controversial Weapon filter

From the selection in 0 we exclude all stocks that are involved in controversial weapon activities, according to the Yes/No flag provided by Sustainalytics.

2.5.2.4 Controversy filter

For each stock in the selection computed in 0 we compute a Controversy category as follows:

At the calculation date, we define the controversy score CS as

$CS = \min(\{G.1.5., G.2.13, G.3.4, E.1.12, E.2.2, E.3.2, S.1.7, S.2.3, S.3.3, S.4.3\})$

The controversy score CS is transformed into a controversy category CC as follows:

$CC = 0$ if $CS = 100$

$CC = 1$ if $81 \leq CS \leq 99$

$CC = 2$ if $51 \leq CS \leq 80$

$CC = 3$ if $21 \leq CS \leq 50$

$CC = 4$ if $1 \leq CS \leq 20$

$CC = 5$ if $CS = 0$

Stocks with $CC = CD$ are excluded from the selection. Parameter CD is defined in Section 0

2.5.2.5 Compliance filter

From the selection in 0 2.5.2.4 Controversy **filter** we exclude all stocks that are involved that are not compliant according to the Yes/No flag provided by Sustainalytics. Compliance status is related, but not exclusively, to ethical issues or corruption.

2.5.3 Missing Data for Liquidity Filter

The eligible Universe consists in those stocks whose recent price history does not exhibit large non trading periods, which could bias the liquidity estimation. For this purpose a missing data filter is designed to perform the following actions:

- a) For each stock, count the Number of Non Trading occurrence (NNT) over the past T_v days
- b) Stocks for whose $NNT_i \geq p\%$ are discarded.

Parameters T_v and p are defined in Section 0

2.5.4 Liquidity Filter

We design a liquidity filter to restrict on the most liquid stocks from the ESG Universe as follows:

Liquidity is estimated for each stock, using most recent transaction volume data. Average Daily Volume (ADV) is calculated as a simple average of daily transaction volume series over the past T_v days. Observations with missing volumes are discarded from the mean calculation. T denotes estimation date, V is volume in number of shares, P is stock price in the index home currency (USD).

$$TD_T^i = \sum_{t=T-T_v+1}^T 1_{\text{volume is not missing}}$$

$$ADV_T^i = \frac{1}{TD_T^i} \sum_{t=T-T_v+1}^T V_t^i * P_t^i * 1_{\text{volume is not missing}}$$

- The stocks from the selection are ranked by their ADV in descending order.
- Each stock is assigned a weight equal to $1/N$, N being the number of stock in the filtered universe
- The first k stocks whose cumulative weight is equal or higher than M are selected.

Parameters T_v and M are defined in Section 0

2.5.5 Missing Data Filter: Volatility estimation

The Eligible Universe consists in those stocks whose recent price history does not exhibit large non trading periods, which could bias the volatility estimation. For this purpose a missing data filter is designed to perform the following actions:

- For each stock, count the Number of Non Trading occurrence (NNT) over the past T_s days
- Stocks for whose $NNT_i \geq q\%$ are discarded

Parameters T_s and q are defined in Section 0

2.5.6 Missing Data Filter: Covariance estimation

The Eligible Universe consists of those stocks which recent price history does not exhibit large non trading periods, which could bias the covariance estimation. For this purpose a missing data filter is designed to perform the following actions:

- for each stock, count the Number of Non Trading occurrence (NNT) over the past T_r days
- stocks for whose $NNT_i \geq q\%$ are discarded

Parameters T_r and q are defined in Section 0

2.6 Portfolio Construction

Index constituents are weighted by an optimization procedure which aims to minimize the portfolio variance under constraints.

2.6.1 Return Data

The optimization procedure starts by calculating daily arithmetic price returns:

$$r_t^i = \frac{TR_t^i}{TR_{t-1}^i} - 1$$

where $t-1$ denotes the previous business day, TR are total return close prices.

2.6.2 Variance Estimation Details

For all the stocks admitted to the optimization step a variance-covariance matrix is estimated as follows:

$$\Sigma_T^{i,j} = \sigma_T^i * \sigma_T^j * \rho_T^{ij}$$

where M is the number of stocks admitted for optimization, σ^i is volatility of the i -th stock, and ρ^{ij} is correlation between the stocks (i,j) . The ingredients of the covariance matrix are estimated on arithmetic daily returns as follows:

$$\sigma_T^i = \sqrt{\frac{1}{T_s - 1} \sum_{t=T-T_s+1}^T (r_t^i - \bar{r}^i)^2}$$

where T denotes Estimation date and Ts is volatility estimation period in days, \bar{r} denotes simple average of stock returns. And correlation coefficients are estimated as

$$\rho_T^{i,j} = \frac{\frac{1}{T_r - 1} \sum_{t=T-T_r+1}^T (r_t^i - \bar{r}^i)(r_t^j - \bar{r}^j)}{\sigma_T^i * \sigma_T^j}$$

where T denotes Estimation date and Tr is correlation estimation period in days, and volatilities in the denominator are estimated over the Ts-day period. Only the days when all the stocks were actually traded are included in the estimation of the means and the variance-covariance

Parameters Ts and Tr are defined in Section 0

2.6.3 Optimization: objective function

The function to be minimized is the variance of the Index portfolio:

$$\sigma_{Ind}^2 = \sum_{i=1}^M \sum_{j=1}^M w_i \Sigma_{ij} w_j$$

2.6.4 Optimization: constraints

The optimization is subject to the following constraints:

- 100% leverage constraint: $\sum_{i=1}^M w_i = 1$
- long-only constraint: $w_i \geq 0$, for all i
- maximal weight constraint: $w_i \leq w_{max}$
- maximal sector exposure constraint: $w_S \leq \mathbf{S}_{max}$ where $w_S = \sum_{i \in S} w_i$, is net exposure to the sector S.
- diversification target: $\sum_{i=1}^M w_i^2 = \frac{1}{H}$

The sector set S is constructed by aggregating the peer groups as in Section 0. Parameters w_{max} , \mathbf{S}_{max} and H are defined in Section 0

2.6.5 Optimization: numerical algorithm

The optimization problem is a quadratic constrained minimization problem. It is solved numerically, using an interior-point algorithm. This algorithm calculates an iterative sequence of approximate minimization problems, where inequality constraints are transformed into equality constraints using slack variables. The optimal solution is defined with the help of the following convergence criteria:

- TolFun : termination tolerance on the function value
- TolCon : tolerance on the constraints violations

- MaxIter : maximal number of iterations allowed

Parameters TolFun , TolCon and MaxIter are defined in Section 0

2.7 Determination of the Minimum Variance Portfolio

As Input data to the optimization as well as intermediate calculations are not rounded, weights in the Optimized Portfolio may be arbitrarily small. Components whose weights are negligible are rounded to 0 and effectively removed from the Minimum Variance Portfolio. A threshold of wtol is used to determine if a weight is negligible. The total weight from negligible stocks that is rounded off is redistributed pro-rata to the remaining stocks. Parameter wtol is defined in Section 0

2.8 Parameters

- B = 30. Best-In-class threshold
- CD = 5. Controversy degree.
- p = 10% maximum share of missing values inside liquidity estimation period accepted
- Tv = 50 days liquidity estimation period
- M = 90% number of the most liquid stocks selected by liquidity filter
- Ts = 125 days variance estimation period
- Tr = 500 days covariance estimation period
- q = 10% maximal share of missing values inside volatility/covariance estimation period
- Wmax = 4.5% maximal weight
- Smax = 20% upper bound for single sector exposure
- Sect. Classif = GICS Sector classification
- H = 50 inverse diversification target
- TolFun = 10^{-8} termination tolerance on the objective function value
- TolCon = 10^{-8} tolerance on constraints violation
- MaxIter = 10^{12} maximal number of iterations
- wtol = 10^{-5} significance threshold for weights
- K = 4 days gap between Estimation date and Rebalancing Date
- TP = 3 days between the announcement of a downgrade in the controversy category and the early exit from the index.

3 Calculation of the Index and treatment of corporate actions and extraordinary events

3.1 Index formula

The US ESG Minimum Variance Index (GR/NR/PR) will be calculated based on Laspeyres formula, which can be found on the <http://www.solactive.com/downloads/Index-Calculation-Guideline-Solactive.pdf>

3.2 Corporate actions and extraordinary events corporate actions and

If a company included in US ESG Minimum Variance Index (GR/NR/PR) is removed from the Index between two ordinary Adjustment Days due to an Extraordinary Event, the weight of the stock will be redistributed amongst the remaining index members. This is announced by Solactive AG after the decision has been made on its webpage. The Indices are adjusted with two days' notice if possible. Other potential extraordinary adjustments might occur. The following table provides guidance on the treatment that will be applied following M&A activity. Additional corporate actions causing Extraordinary Events are covered in chapter 4 of this document. For all the cases not explicitly mentioned in this document the maintenance is made according to Solactive corporate action methodology, which can be found on the <http://www.solactive.com/downloads/Index-Calculation-Guideline-Solactive.pdf>.

Event	Adjustment	Adjustment Treatment
Acquisition (only Target Company is in the Index)	Yes	If the acquired constituent is delisted, the stock is removed and the proceeds are reinvested proportionally (based on the current weight) among the other constituents. This is independent as to whether the transaction has been paid for using cash, stock or a combination of both.
Acquisition or Merger (both Acquirer and Target Company are in the Index)	Yes	If the acquired constituent is delisted, the stock is removed and the cash received in the transaction is proportionally distributed to the remaining index components. In case the transaction is financed entirely or partly with new shares, then the shares of the acquirer in the index are increased accordingly, leading to an increased Market Capitalization and weight within the index.
Spin Off	Yes	The spun off company is added to the index on the ex date according to the terms of the spin off. At the next rebalancing, the eligibility of the company is reviewed according to the criteria outlined in this methodology.

Event	Adjustment	Adjustment Treatment
Changes in Controversy Category	Yes	At any time, if a company in the index whose controversy category is downgraded, according to the transformation in 0, to category CD after notification from Sustainalytics to Solactive, then the company is dropped from the index after TP trading days, and its weight is distributed, on a pro-rata basis, to the rest of the index. Should this happen between the Calculation Date (K-1 days before the Rebalancing Date) and the day before the Rebalancing Date, then the company is dropped at the Rebalancing Date and its weight is distributed, on a pro-rata basis, to the rest of the index.

3.2 Precision

The value of the Index will be rounded to 2 decimal places.

3.3 Calculation of the Index in the event of a Market Disruption Event

The Index is not calculated in the event of a Market Disruption Event or Force Majeure Event. If the Market Disruption Event or Force Majeure Event continues over a period of eight Trading Days, then the Committee will determine the necessary action (including but not limited to taking into account the market conditions prevailing at this point in time, the last quoted Trading Price for each of the Index Components as well as any other conditions that it deems relevant for calculating the Index value) such that the affected securities resulting from the Market Disruption Event are no longer causing such disruption to occur.

4 Definitions

“**Index Component**” is each stock currently included in the Index.

“**Number of Shares**” is in respect of an Index Component and any given Business Day the number of shares included in the Index.

“**Percentage Weight**” of an Index Component on any given day can be calculated according to the following formula: (Trading Price in Index Currency day (t) * Number of Shares day (t) * 1/Divisor day (t)) / Index value day (t)).

In particular an “**Extraordinary Event**” is

- a Merger
- a Takeover bid
- a delisting
- the Nationalisation of a company
- Insolvency.

The Trading Price for this Index Component on the day the event came into effect is the last available market price for this Index Component quoted on the Exchange on the day the event came into effect (or, if a market price is not available for the day the event came into effect, the last available market price quoted on the Exchange on a day specified as appropriate by the Index Calculator).

In the event an Index Component announces insolvency, the Index Component shall remain in the Index until the next Adjustment Day as long as a market price for the affected Index Component is available on a Business Day. If a market price is not available on a Business Day the Trading Price for this Index Component is set to zero and removed from the index with the index weight being redistributed proportionally. The Committee may also decide to eliminate the respective Index Component at an earlier point in time prior to the next Adjustment Day. The procedure in this case is identical to an elimination due to an Extraordinary Event.

“**Insolvency**” occurs with regard to an Index Component if (A) all shares of the respective issuer must be transferred to a trustee, liquidator, insolvency administrator or a similar public officer as result of a voluntary or compulsory liquidation, insolvency or winding-up proceedings or comparable proceedings affecting the issuer of the Index Components or (B) the holders of the shares of this issuer are legally enjoined from transferring the shares.

A “**Takeover bid**” is a bid to acquire, an exchange offer or any other offer or act of a legal person that results in the related legal person acquiring as part of an exchange or otherwise more than 10% and less than 100% of the voting shares in circulation from the issuer of the Index Component or the right to acquire these shares, as determined by the

Index Calculator based on notices submitted to public or self-regulatory authorities or other information considered by the Index Calculator to be relevant.

With regard to an Index Component a **“Merger”** is

- (i) a change in the security class or a conversion of this share class that results in a transfer or an ultimate definite obligation to transfer all the shares in circulation to another legal person,
- (ii) a merger (either by acquisition or through forming a new structure) or a binding obligation on the part of the issuer to exchange shares with another legal person (except in a merger or share exchange under which the issuer of this Index Component is the acquiring or remaining company and which does not involve a change in security class or a conversion of all the shares in circulation),
- (iii) a takeover offer, exchange offer, other offer or another act of a legal person for the purposes of acquiring or otherwise obtaining from the issuer 100% of the shares issued that entails a transfer or the irrevocable obligation to transfer all shares (with the exception of shares which are held and controlled by the legal person), or
- (iv) a merger (either by acquisition or through forming a new structure) or a binding obligation on the part of the issuer of the share or its subsidiaries to exchange shares with another legal person, whereby the issuer of the share is the acquiring or remaining company and it does not involve a change in the class or a conversion of the all shares issued, but the shares in circulation directly prior to such an event (except for shares held and controlled by the legal person) represent in total less than 50% of the shares in circulation directly subsequent to such an event.

The **“Merger Date”** is the date on which a Merger is concluded or the date specified by the Index Calculator if such a date cannot be determined under the law applicable to the Merger.

“Nationalisation” is a process whereby all shares or the majority of the assets of the issuer of the shares are nationalised or are expropriated or otherwise must be transferred to public bodies, authorities or institutions.

A **“Business Day”** is any day where the New York Stock Exchange and/or NASDAQ are open for trading.

The **“Index Calculator”** is Solactive AG or any other appropriately appointed successor in this function.

The **“Index Currency”** is USD.

“Market Disruption Events” relate to all events causing a halt to regular pricing for any of the index components or the market in general.

5 Appendix

4.1 Contact data

Information regarding the US ESG Minimum Variance Index (GR/NR/PR) concept

Solactive AG

Guiollettstr. 54

60325 Frankfurt am Main

Phone: +49 (0) 69 719 160 0

Fax: +49 (0) 69 719 160 25

ca@solactive.com

4.2 Calculation of the Index – change in calculation method

The application by the Index Calculator of the method described in this document is final and binding. The Index Calculator shall apply the method described above for the composition and calculation of the Index. However it cannot be excluded that the market environment, supervisory, legal, financial or tax reasons may require changes to be made to this method. The Index Calculator may also make changes to the terms and conditions of the Index and the method applied to calculate the Index, which he deems to be necessary and desirable in order to prevent obvious or demonstrable error or to remedy, correct or supplement incorrect terms and conditions. The Index Calculator is not obliged to provide information on any such modifications or changes. Despite the modifications and changes the Index Calculator will take the appropriate steps to ensure a calculation method is applied that is consistent with the method described above.