

ESG Factor-In Methodology

July 2026



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Model Change Log

Current Version	
Owner	SFI, Model Owner
Department	Sustainable Finance & Investment
Current Version	3.0
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Next Review Due date	01/07/2027

Version Control Table:

Effective Date	Methodology Document Version Number	Model Version Number	Description of Key Changes from Previous Version
01/07/2026	1.0	3.0	First publication designed to support applicable regulatory disclosures.

Regulatory Information

For the purposes of Regulation (EU) 2024/3005 on the transparency and integrity of ESG rating activities, Refinitiv France SAS is the ESG Rating Provider responsible for the issuance of the relevant ESG ratings within the European Union.

This document describes the methodology used for the production of ESG ratings and related products distributed globally under the LSEG brand. References to LSEG products, methodologies, governance frameworks and related disclosures reflect the global operating framework supporting those products and services.

This methodology document forms part of the disclosure framework established to support compliance with the Regulation (EU) 2024/3005 and should be read together with the publicly available disclosure documents at: <https://www.lseg.com/en/data-analytics/sustainable-finance/regulatory-disclosures>.

The use of the LSEG brand in this document is for branding purposes only and does not affect, modify or supersede the identification of the ESG Rating Provider for the purposes of Regulation (EU) 2024/3005.

Executive Summary

LSEG D&A ESG scores measure an item’s relative performance on fundamental ESG attributes, commitment, and effectiveness across ESG factors. The scores are derived using a proprietary, rule-based methodology applied to publicly available information from sources believed by the London Stock Exchange Group (LSEG) to be reliable; however, the accuracy and completeness of such information cannot be guaranteed. The scores are provided for informational purposes only and do not constitute investment advice or a recommendation. They should not be relied upon as the sole basis for any decision. LSEG makes no representations or warranties and accepts no liability for any loss or damage arising from the use of, or reliance on, the scores.

Sovereign debt is a major asset class but has been the subject of less systematic ESG considerations compared to other investment asset classes. ESG Factor-In model offers a robust framework for assessing country ESG performance and identifying the ESG factors that impact country economic growth.

The ESG Factor-In model provides a statistical and agnostic approach to ESG analysis by linking country economic performance and ESG. This quantitative model assesses the overall ESG performance of a country relative to its peers, highlighting the ESG factors that contribute to the sustainable growth of a country.

Benefits

- More efficient screening: our statistical model allows for quickly identifying absolute and relative country ESG performance, and quickly focussing on the ESG factors that matter to a country’s economic growth
- Optimize portfolio allocation: leverage insights on countries to support portfolio diversification, and monitor performance discrepancies between E, S, G, and GDP as harbingers of upcoming market corrections
- Enhance reporting impacts: use our sustainable GDP metric to support communication between asset owners and managers on the ESG performance of sovereign mandates
- Monitor ESG performance across multiple levels: track performance at the score, pillar, and indicator level
- Customize to customer needs: our quantitative model allows for modification of pillar weights to reflect individual ESG priorities

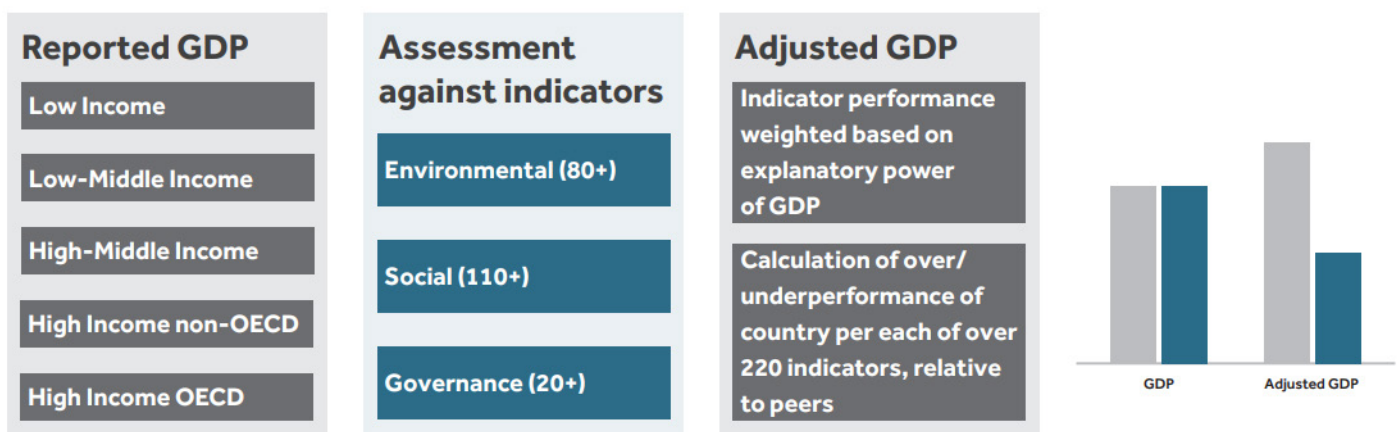
Features

- Comprehensive coverage: Over 175 countries covered, with historical data updated annually going back to 2000.
- Data granularity: Scores available on multiple levels, allowing insights to be drawn at pillar, sub-pillar, and theme levels.
- Transparent methodology: Our quantitative framework provides clarity on the materiality of ESG factors in country GDP

ESG Factor-In model structure

ESG Factor-In is based on an econometric model that employs Partial Least Squares (PLS) regressions to determine the materiality of over 220 Environment, Social, and Governance indicators. As the materiality – defined as impact on country GDP over the last 15 years – of a specific indicator differs according to the level of economic development of countries, we have built five sub-models for country groups. Each sub-model identifies the most relevant ESG factors and evaluates country performance on these indicators relative to its peers. The final output is the Sustainable GDP, a measure of the country’s efficiency of wealth to generate ESG performance. The framework presented above is briefly summarized in Figure 1.

Figure 1. GDP Adjustment Framework



1. Methodology Overview

The ESG Factor-In framework is a dataset which aims at assessing the ESG performance of a country compared to its wealth. The first part introduces the concept of the Sustainable GDP which evaluates the impact a certain country has on the global scene relative to its wealth. The second part explains the chosen econometric approach (scoring and Partial Least Squares regressions). From a materiality standpoint, both the impact and risk components are included in the present assessment, a mix of both is present in all three of the pillars. An example could be that both governmental policies and corporate behaviour affect the Pollution theme.

It is also worth noting that the following model approach is not based on any scientific evidence.

1.1 The Sustainable GDP

1.1.1 A quantitative approach to assessing the level of development of countries

As numerous academic and empirical studies can attest, economic metrics alone are insufficient in measuring a country's level of development. We can cite the Human Development Index (HDI, corrected for inequalities or not), the Inclusive Wealth Indicators (IWI) and the Sustainable Development Goals (SDG) proposed by the United Nations, the complementary indicators to GDP calculated by the European Statistical Office (Sustainable Development Indicators, SDS) and many other national statistical bodies (Netherlands, Bhutan, France, etc.) or the Social Progress Index (SPI) proposed by Harvard University and the professor of strategic management Michael Porter. Each of these approaches makes it possible to define sets of indicators (aggregated or distinct) characterising a model of sustainable development¹ referring to the three main usual axes (Environment, Social and Governance / ESG).

1.1.2 Assessing the level of ESG development: the concept of sustainable GDP

We define the Sustainable GDP as the theoretical GDP that is consistent with the level of E, S or G achieved by a country and therefore consider that at the same or similar level of economic wealth, sustainability differs according to the levels of development achieved (across E, S and G). These levels are characterised on the basis of over 210 indicators, whose weights depend on the level of income (as defined by the World Bank Atlas method country classification). These weights are obtained by advanced statistical techniques whose objective is to reproduce GDP in purchasing power parity. The three scores thus calculated reflect the real levels of development E, S and G for a given economic development and are called the Sustainable E, S and G GDPs. If they are equal to real GDP, the two axes of co-development are consistent; if the Sustainable GDP is higher than the real GDP, the wealth produced has made it possible to achieve higher E, S or G performance than that of its peers (and vice versa).

We draw the reader's attention to the fact that at certain stages of a country's economic development, the increase in wealth comes at the expense of certain ESG criteria. For this, we refer the reader to the work of Simon Kutznets and the eponymous curve ². In the context of the methodology, this may result in counter-intuitive weights of some indicators in the assessment of adjusted GDP. This reflects standardised sequences in country development cycles.

This quantitative approach offers a framework for practical use by providing a single indicator (the Sustainable GDP) comparable to real GDP. Indeed, the latter remains, despite its many limitations, a reference in the assessment of economic growth. The Sustainable GDP scores therefore make it possible to highlight information that is missing from the traditional accounting approach, by means of statistical reconstitution.

1.2 Sustainable GDP, ESG Performance and Scores

Please note that the key calculation steps of this model are visually summarised in flow charts in Appendix, in addition to the description in the core of the document.

Selection of indicators

ESG Factor-In model ingests over 200 E, S and G indicators from several sources. These include proprietary data and public data as shown below in Table 1. Both sets of data are handled by a data manager, who specialises in receiving, validating and storing all raw data (Refer to Data Collection Process section for more details). The data manager keeps a schedule of when all raw inputs are updated and when they should be validated. In this way, it is assured that each update has the latest available data for the yearly delivery of December.

Table 1. List of data providers for the inputs used in the model computation

Enerdata ³

¹ in the sense of RIO92

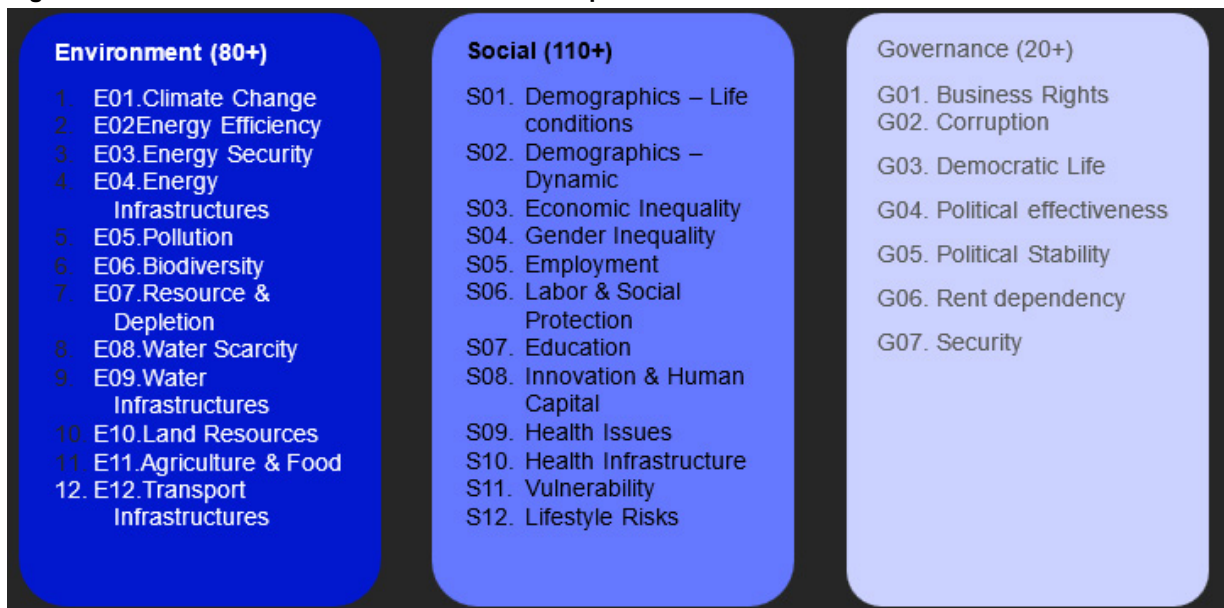
² The Kutznets curve hypothesizes that industrialising nations experience a rise and subsequent decline in income inequality, and has been applied to environmental issues as well

³ For more information about the Enerdata dataset, please refer to this document: [Global Intelligence & Data Platform](#)

World Bank (World Development Indicators ⁴ , World Government Indicators) ⁵
International Institute for Applied Systems Analysis: IIASA (LULUCF) ⁶
International Road Federation (World Road Statistics) ⁷
Institute for Crime & Justice Policy Research (ICPR) ⁸
World Health Organization ⁹
Postdam Institute for Climate Impact Research (Primap-Hist database) ¹⁰
The Fund for Peace ¹¹
United Nations (SDG dataset, Population) ¹²

Source: LSEG Sovereign Sustainable Solutions, 2025
 LSEG Sovereign Sustainability own data (CLAIM model, Energy/GHG emissions efficiency...)^{13,14}

Figure 2. Breakdown of the themes included in the pillars



Source: LSEG Sovereign Sustainable Solutions, 2025

In Figure 2., the approximate number of indicators allocated per pillar is mentioned along with the themes assessed in each pillar.

The restriction to a small number of data sources and the credibility of the providers ensure the consistency of the information and a wide coverage of the countries studied.

⁴ For more information, please refer to [WDI - Home](#)

⁵ For more information, please refer to [Home | Worldwide Governance Indicators](#)

⁶ For more information, please refer to https://globiom.org/documents/GLOBIOM-G4M_documentation_LULUCF_2024.pdf

⁷ For more information, please refer to [IRF Scientific Proceedings: Sharing Knowledge Across Borders](#)

⁸ For more information, please refer to: [prison_data_collection_guidance_note_0.pdf](#)

⁹ For more information, please refer to [World Health Statistics](#)

¹⁰ For more information, please refer to: <https://doi.org/10.5194/essd-8-571-2016>

¹¹ For more information, please refer to: [Methodology | Fragile States Index](#)

¹² For more information, please refer to [SDG Indicators — SDG Indicators](#)

¹³ For more information about CLAIM, refer to this link: <https://shs.hal.science/halshs-01673358v1>

¹⁴ For more information about the energy/GHG emission indicators, please refer to this document: [Sovereign Sustainability Solutions: Sovereign Climate KPIs - Methodology \(Process\)](#)

Pre-transformation of indicators

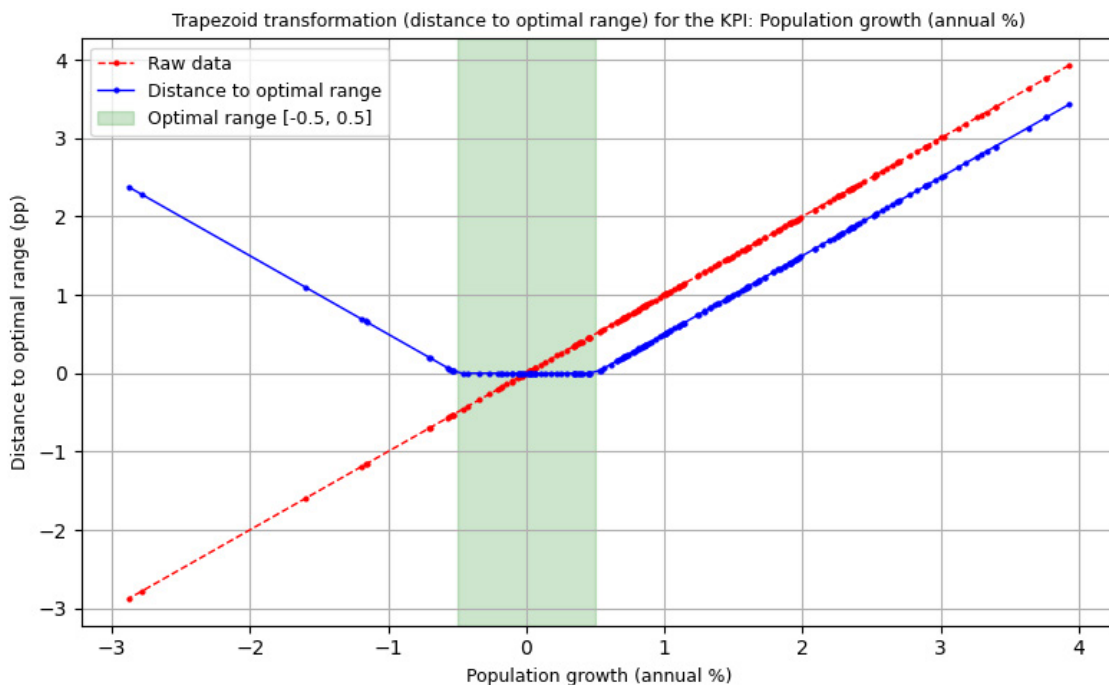
There are indicators that would need a specific way of pre-transformation due to the fact that they cannot be classified as having a positive (the higher the value, the better) or a negative polarity (the lower the value, the better) such as fertility rate, population growth, taxes, government expenditure, etc. which would need an optimal value approach. Therefore, the indicators with an optimal value will be pre-transformed before moving forward with proceeding with the calculation (expected value and performance).

Trapezoid transformation

This typically applies when both very low and very high values are undesirable.

Figure 3. Trapezoid transformation visualisation

Population growth rate (%) falls into this category in our classification. The optimal value lies within the range [-0.5%, 0.5%]. A trapezoid transformation is applied to derive the distance to the optimal value. The best countries (i.e. those within the optimal range) will have a distance of 0, and the farther they are from the range, the higher their distance will be.



N.B:

The polarity for indicators requiring a trapezoid transformation must be set to negative (sign = -1), because the higher the distance, the farther the country from the optimal range.

Table 2. Examples of indicators with optimal values

Indicator	Unit	Pre transf	Sign
Fertility rate, total (births per woman)	RATIO	Trapezoid	-1
Labor tax and contributions (% of commercial profits)	%	Trapezoid	-1
Employment in industry (% of total employment)	%	Trapezoid	-1
Military expenditure (% of GDP)	%	Trapezoid	-1
Total Four-wheeled Vehicles in Use Rate by Population	Vehicle / 1,000 pop	Trapezoid	-1
Young population ratio (0-14 / 15-64)	Ratio	Trapezoid	-1
Net migration as % of population	%	Trapezoid	-1

Source: LSEG Sovereign Sustainable Solutions

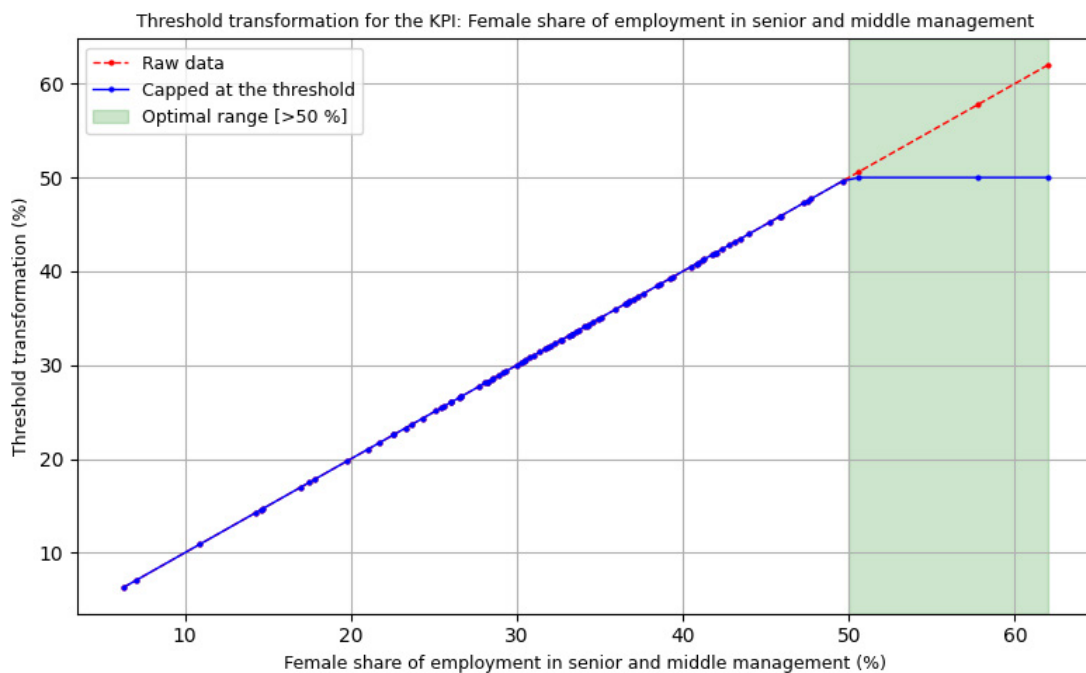
Threshold Transformation

A transformation where values below a certain threshold are considered “not good” and values at or above the threshold are considered “good” if the indicator has a positive polarity.

If the indicator has a negative polarity, values above a certain threshold are considered “not good” and values at or below the threshold are considered “good”.

Figure 4. Threshold transformation visualisation

Female share of employment in senior and middle management (%) falls into this category in our classification. The optimal value is 50% or higher (i.e., it is acceptable if women outnumber men in these positions). For such indicators the acceptability of a value would be looked at as reaching a predefined threshold rather than exceeding it by a certain magnitude. Once the threshold is met or exceeded, the value is capped at the threshold in the model calculation, and any further increase does not affect the outcome.



1.2.1 Weights calculation (PLS regression)

The weight assigned to an indicator for a given country depends on the income group the country belongs to. The weights are obtained by 5 models of Partial least squares (PLS) regression (a specific model for each of the 5 income groups) and they reflect the indicators materiality to countries or their explicative capacity of countries wealth (GDP per capita \$PPP).

A high weight means the indicator is a differentiating factor to countries in the same income group (e.g. “% of population with access to electricity” for low-income countries) and a low weight means the indicator makes little difference (e.g. “% of population with access to electricity” for high-income OECD countries as they all have around 100% access to electricity).

1.2.2 Expected value and performance

New values are included in the computation of the “Expected” values and in the “Performance” ones as further presented below.

Expected value:

The expected value is derived from the raw data (imputed and winsorised) using LOESS¹⁵ locally weighted smoothing algorithm. The parameters are selected in such a way as to achieve robust and optimal smoothing (i.e. ignore outliers). The GDP per capita is used as abscissa in this smoothing.

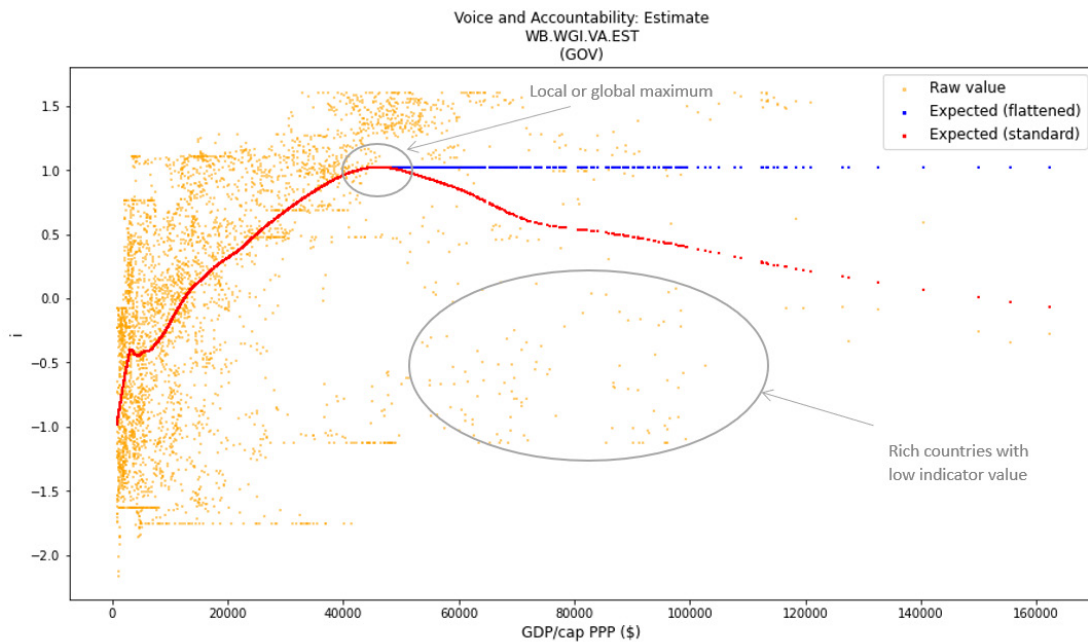
An illustration of the expected value curve for the indicator “Voice and Accountability: Estimate (index)” is given in

Figure 1. The orange dots represent the indicator value (ordinate) for each country in each year versus the GDP/cap (abscissa) for the same country in the same year.

The red curve is a standard LOESS smoothing without any additional constraints. As can be seen, for some indicators like “Voice and Accountability: Estimate (index)”, after a local or global maximum within 40k-60k, the expected value decreases for very high GDP/cap because some very wealthy but weaker peers pull the expected value down. And this gives an advantage to very wealthy countries (we expect less from them).

The blue curve on the other hand is like the red one, but the local or global maximum encountered within 40k-60k is extended to flatten the curve (to prevent the curve from decreasing). That is, we expect the same level from wealthy countries > 60k as the global or local best country (which is also a wealthy country as its GDP/cap > 40k).

Figure 15: Value and expected value for the indicator “Voice and Accountability: Estimate (index)” vs GDP/cap (2000 – 2024, all countries with available data)



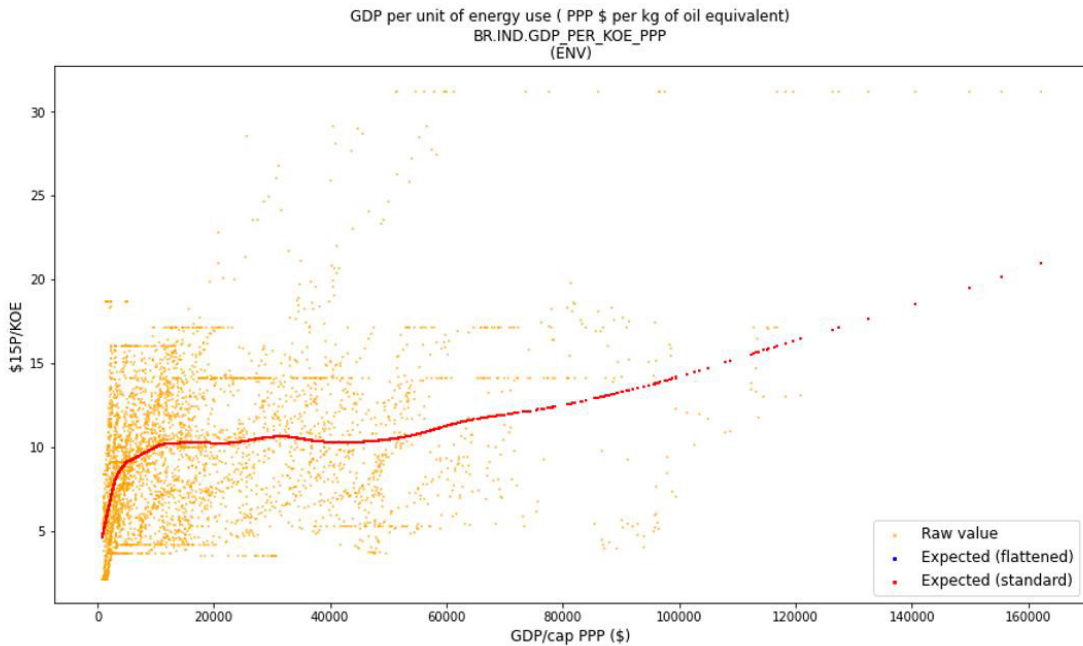
Source: LSEG Sovereign Sustainability Solutions: ESG Factor-In Model

For other indicators like “GDP per unit of energy use (PPP \$ / KOE)” in Figure 6

¹⁵ Locally Estimated Scatterplot Smoothing

Figure 2 the expected value keeps increasing even after 60k GDP/cap (higher expectations for higher income). In this case, we keep the expected value as is (no curve flattening is performed).

Figure 26: Value and expected value for the indicator “GDP per unit of energy use (PPP \$ / KOE)” vs GDP/cap (2000 – 2024, all countries with available data)



Source: LSEG Sovereign Sustainability Solutions: ESG Factor-In Model

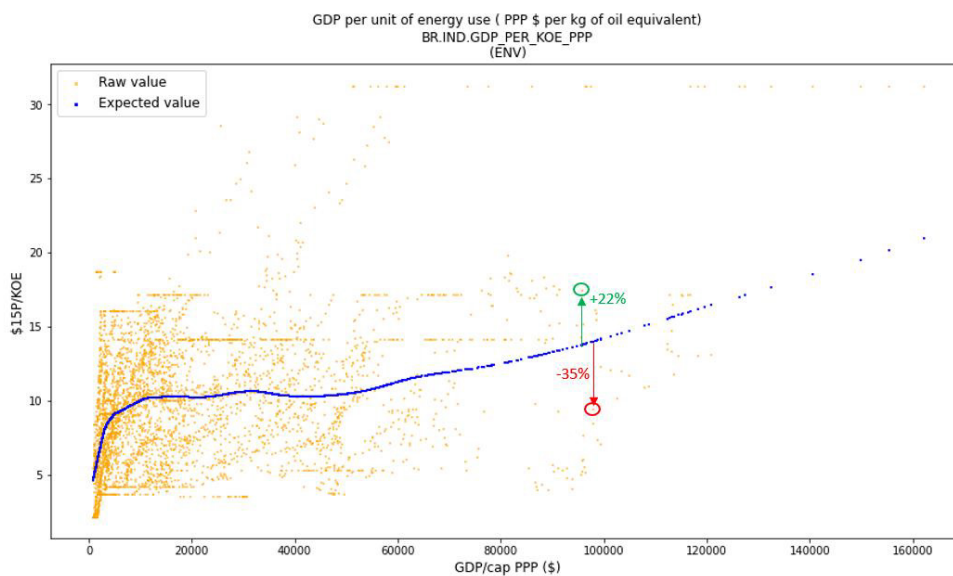
The expected value is the expected indicator value of a country given its level of wealth. It can also be viewed as a peer average (i.e. the average value of countries with similar wealth).

Performance:

The performance (or the gap) for a country on an indicator for a given year is the gap between the country’s raw value and its expected value.

The green and the red arrows in **Figure 3** are two examples of performance. +22% means that the country in that year performs 22% better than countries with similar GDP/cap and -35% means 35% worse than countries with similar GDP/cap.

Figure 37: Performance (gap) for the indicator “GDP per unit of energy use (PPP \$ / KOE)” vs GDP/cap (2000 – 2024, all countries with available data)



Source: LSEG Sovereign Sustainability Solutions: ESG Factor-In Model

1.2.3 Country groupings

Another particularity of the Sustainable GDP calculations is that they are assessed by groups of countries that are homogeneous in terms of economic development. Indeed, we consider that a country develops according to sequences and that social indicators do not progress uniformly with the wealth produced. As an example, the marginal improvement of demographic indicators (e.g. mortality rate) proves to be stronger in low-income countries than in more mature economies. The weighting of these indicators will therefore be different according to the categories of countries studied. More generally, the way in which the 210+ variables interact therefore depends on the level of development of the country under consideration.

Countries are split into the following groups:

- High Income OECD
- High Income Non-OECD
- Upper Intermediate Income
- Lower Intermediate Income
- Low Revenues

1.2.4 Calculation of scores

Sustainable GDP: Depending on one's conviction on the order of importance of the 3 pillars, the end user can define a sustainable GDP as the weighted average of the three sustainable GDPs, and specify the associated weights. The agnostic version of sustainable GDP is obtained as a simple average of the three components ($ESG = 1/3 * E + 1/3 * S + 1/3 * G$).

ESG, E, S, and G Performance: Based on the 4 sustainable GDPs thus estimated (E, S, G and ESG), we define a country's performance E (resp. S, G and ESG) as the relative gap between real GDP and sustainable GDP E (resp. S, G and ESG). It represents a form of sustainability level of the produced wealth as well as the capacity of a state to act on the long-term determinants covered by the ESG perimeter.

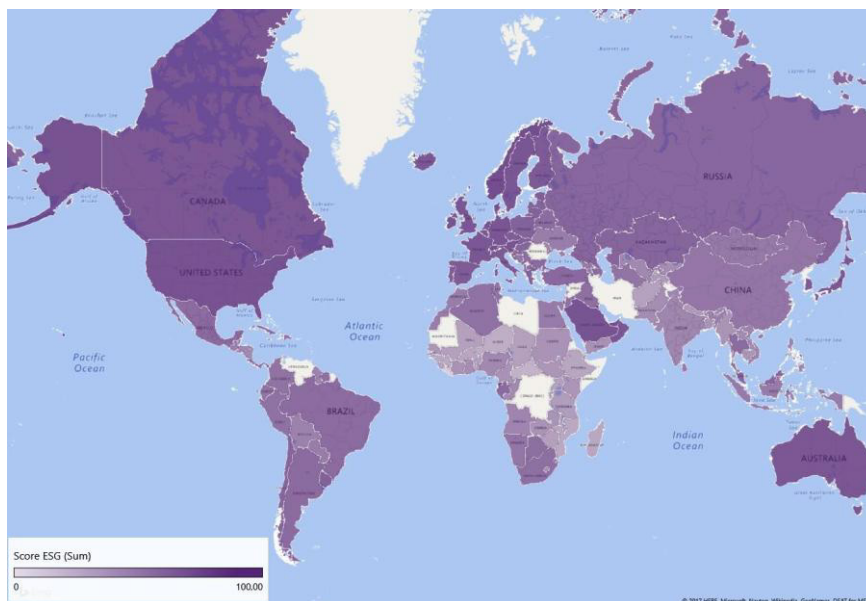
ESG, E, S, and G Scores: they are normalised between 0 and 100, and defined by the following formula:

$$Score_{p,q} = \frac{(\log(\text{adjusted } GDP_{p,q}) - \min_q(\log(\text{adjusted } GDP_{p,q})))}{((\max_q(\log(\text{adjusted } GDP_{p,q})) - \min_q(\log(\text{adjusted } GDP_{p,q})))}$$

Where p refers to the country and q the pillar under consideration (E, S, G or ESG). The logarithmic transformation is justified by the global distribution of per capita income.

In Figure 8 below, we represent the world map of scores in October 2024: the darker the purple, the better the score and vice versa. The weight k is set to 0 (basic version).

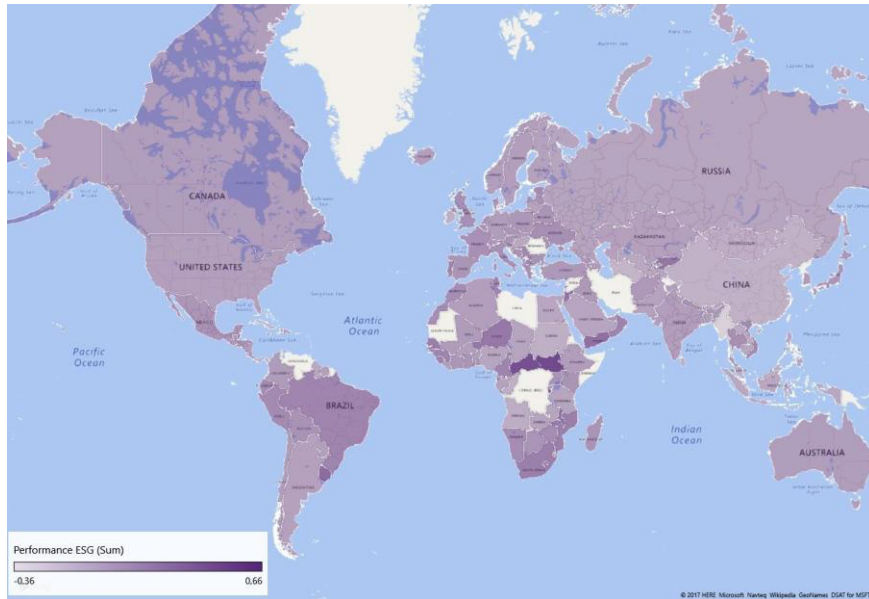
Figure 8: 177 countries covered from 0 (lowest adjusted GDP) to 100 (best GDP)



Source: LSEG as of October 2024

In Figure 9 below, we represent the world map of ESG performance in October 2024: the darker the purple, the better the ESG score relative to the level of development.

Figure 9: 177 countries covered from 0 (worst performance) to 100 (best performance)

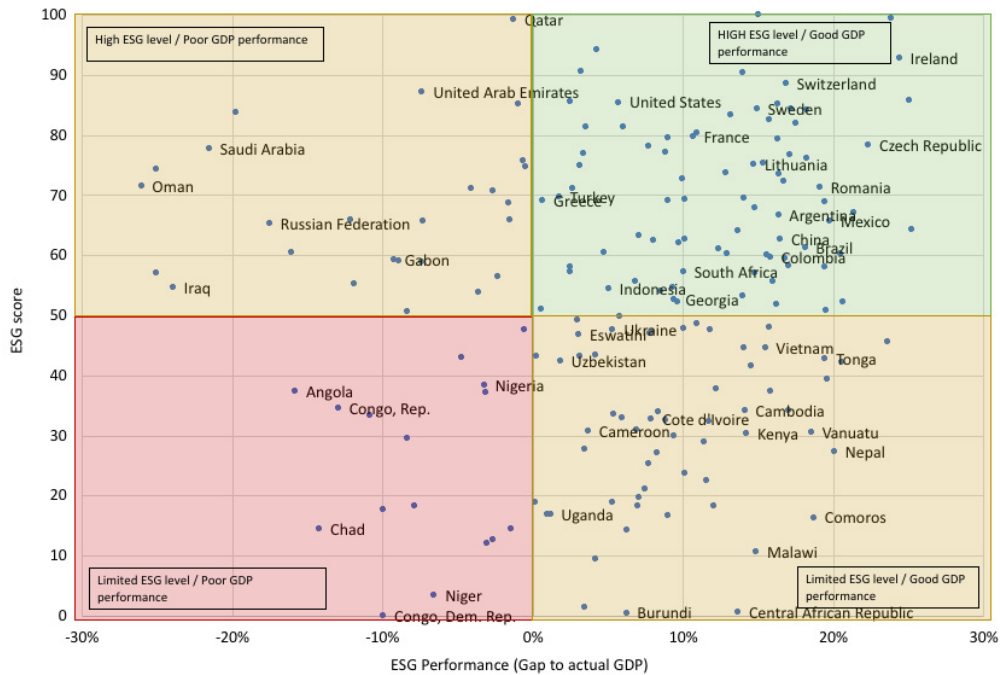


Source: LSEG as of October 2024

This two-component approach (absolute level and performance brought back to its level of development) offers a contrasting vision that enables different levels of economic development to be taken into account.

In **Figure 10** below, we plot country ESG scores against their ESG performance. Countries are grouped into four quadrants representing different levels of ESG performance. Countries situated in the bottom-left quadrant are those with low ESG scores and negative ESG performance, indicating that ESG scores are poor both in absolute terms and relative to their (economic) peers. Countries situated in the bottom-right quadrant are those with low ESG scores but with positive ESG performance, meaning that while their absolute ESG scores are low, their ESG performance is higher than their peer-group average. Countries situated in the top-left quadrant represent countries in the opposite situation, i.e. with high absolute ESG scores but negative ESG performance, which indicates that their ESG performance is lower than that of their peers. Finally, countries in the top-right quadrant are those that score positively both in terms of their absolute ESG score and ESG performance.

Figure 10: ESG Scores and ESG Performance



Source: LSEG as of October 2024

1.3 Limitations, assumptions and mitigation steps

The methodology is subject to data and modelling limitations inherent to multi-source ESG datasets and econometric techniques. Source coverage varies across countries, indicators and time, which may affect comparability, particularly for lower-income countries; this is mitigated through the use of curated data providers and systematic validation processes. Missing data are handled through rule-based imputation (carry-forward/backward or interpolation) and neutral assumptions for fully missing series, with smoothing applied to reduce artefacts. The econometric framework relies on statistical assumptions from PLS regressions and LOESS smoothing (e.g., linear relationships, local stability, and noise reduction), which may not fully capture structural breaks; these are mitigated through income-group-specific models, parameter calibration and robustness checks. Income-group segmentation improves comparability but may introduce boundary effects; this is addressed by using homogeneous peer groups and development-adjusted benchmarking. Outliers are controlled through winsorisation and smoothing techniques, while ongoing monitoring and validation controls (including threshold-based flagging and expert review) mitigate data and model drift over time.

Table 3. Limitations description and mitigation measures

Limitation	Potential impact	Mitigation
Uneven source coverage	Reduced comparability across countries/time	Curated data sources, annual refresh, standardized validation checks
Imputation of missing data	Potential bias or smoothing of true dynamics	Transparent hierarchical rules (carry-forward/backward, interpolation, neutral assumptions) + smoothing
PLS / LOESS assumptions	May not capture non-linearities or structural breaks	Income-group models, parameter calibration, robustness checks
Income-group segmentation	Boundary effects and within-group heterogeneity	Peer-group modelling and development-adjusted benchmarking

Outliers in raw data	Disproportionate influence on results	Winsorisation, LOESS smoothing and transformation rules
Data/model drift	Gradual degradation of signal quality	Threshold-based monitoring, validation checks, SME review

Table 4. Shortcomings description and mitigation measures

Shortcoming	Description	Mitigation
Statistical model assumptions	PLS and LOESS rely on assumptions about relationships and local structure	Use of multiple sub-models by income group, calibration and stability checks
Imputation reliance	Missing data handling may introduce estimation bias	Rule-based imputation hierarchy and neutral performance assumptions for missing series
Coverage limitations	Data gaps across countries, indicators and years	Multi-source integration, annual updates, and validation of completeness
Income-group segmentation	Grouping may mask heterogeneity within categories	Use of granular income groups and relative (peer-based) benchmarking
Outlier treatment	Winsorisation and transformations may suppress extreme but valid signals	Conditional application and consistency across indicators
Monitoring and controls	Residual errors or anomalies may persist after processing	Automated checks, threshold flagging, expert review and documented overrides

2. Data Collection Process¹⁶

Input data is collected on a yearly basis for the December refresh. The full history is revised every year to ensure the consistency across the full period. For the full list of data providers, refer back to Table 1. Input data is collected from website through flat files. The list of Quality Checks that are performed on input data are available in the Model Input/Output Validation section.

Any changes are captured by the data the model uses without any intervention outside the present methodology.

The data sources are not mapped against sustainability statements under CSRD or from information disclosed under SFDR, or EU Taxonomy.

Access to nonpublic data is performed in two ways, depending on the provider. Where supported, we access the data directly through the provider's platform using authorized login credentials supplied for this purpose and managed in accordance with our security controls. Alternatively, when direct access is not available or when automation is required, we retrieve the data via the provider's API, using a Python-based script to authenticate, request, and process the data securely and in line with the provider's technical and usage requirements.

For the input data checks, some comparisons are done between:

- the previous update and the new one;
- the new update and reference tables (which contains metadata details).

The process is recorded in a csv log file. These checks are standardised to be applied to all the sources used to populate the database.

1. Metadata checks:

- a) Comparisons between countries from the golden data (i.e., data already stored and used for different products) newly imported and the country reference table → check if all countries codes are on the reference table and if codes are the same. A pop-up appears during the ingestion process with the discrepancies:
 - i. we can choose to continue the process without updating the reference table (if discrepancies concern regions for example);
 - ii. we can update the reference table before further ingestion (add missed countries for example).
- b) Comparisons between indicators metadata details:
 - i. check if a golden data is missed;
 - ii. check if unit of indicators newly imported is the same as the one described in metadata table. Comparison between data points for the 2 latest updates:
- c) check if data imported contain data for all the countries previously imported or if some countries are missed or added;
- d) check if both new and old value are null;
- e) list all data points which match with $\text{abs}(\text{new_value}/\text{old_value}-1) > 0.3$;
 - i. for indicators with percentage unit, only those with $\text{abs}(\text{old_val}-\text{new_val}) > 5$
 - ii. for indicators with constant prices and deflator, calculate the ratio of $\text{value}_n - 1/\text{value}_n$ for each year and check if this ratio is constant.
- f) list all data points which the new value is null and the old value not;
- g) list all data points which the old value is null and the new value not;
- h) list all data points for which the new value $< \text{average} - 3 * \text{std deviation}$;
- i) list all data points for which the new value $> \text{average} + 3 * \text{std deviation}$;
- j) list indicators with unique value in time series;
- k) list indicators for which the unit have changed between the previous and the new update;
- l) list indicators for which unit is null and value not;
- m) list indicators missed or added between the 2 updates;
- n) list of data overruled on the previous update, the value overruled and the new value.

Once all these checks files are validated, data are recorded in the final table which contains all data points (raw data and computed data).

¹⁶ No AI was used in the data collection or rating process, and the rating methodology is not based on scientific evidence

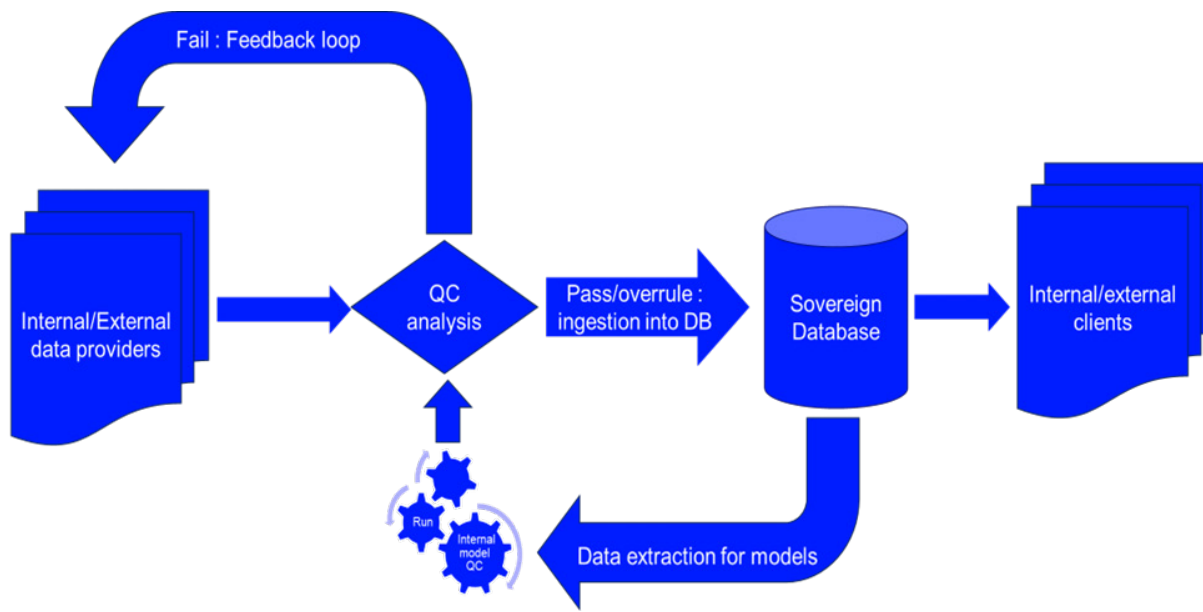
2.1 Model Coverage

Countries were chosen based on data availability.

3. Model Management

3.1 Model Input/Output Validation

Figure 11. General Quality Assurance process diagram



Data validation is a process that encompasses all activities aimed at identifying, processing, and, if necessary, correcting data entering the SFI information systems. The importance of this process lies in the fact that the data is later used by internal or external clients. This process is centralized upstream of the Sovereign DB, which is the master database for sovereign SFI data. The data checks are performed before each model run (for the input data) and after each model run (for the output data), the model is refreshed annually. The scores are considered valid at any point in time after the latest refresh. It consists of three parts:

1. Metadata checks:

1. Comparisons between countries from the “golden” data (*i.e.*, data already stored and used for different products) newly imported and the country reference table è check if all countries codes are in the reference table and if codes are identical.
After checks, discrepancies can:
 1. Either be ignored if it does not impact downstream flow
 2. Or lead to an update in the reference table before further ingestion (add missing countries for example).
2. Comparisons between indicators metadata details:
 1. check if a golden data is missing;
 2. check if units of indicators newly imported are the same as the ones described in metadata table.

2. Model specific checks:

1. The top 30 countries by GDP, the top 30 countries by population, the High-Income OECD countries and the High-Income Non-OECD countries with a population over 500.000 are in scope of the checks

2. All pillar scores and performance scores with a gap larger than 15 percentage points are flagged and the underlying indicators are used to provide a narrative – please note that the threshold can be adjusted so that a minimum of countries is validated, the value of 15 represents the maximum value.
3. **Comparison between data points for the latest 2 updates allows to flag suspicious datapoints:**
 1. check if imported dataset contains data for all the countries previously imported or if some countries are missing or have been added;
 2. check if both new and old values are null; 17
 3. list all data points where $\text{abs}(\text{new value}/\text{old value}-1) > 0.3$;
 1. for indicators expressed in percentage, only those with $\text{abs}(\text{old value} - \text{new value}) > 5$ are flagged
 2. for indicators with constant prices and deflator, calculate the ratio of $\text{value}_{n-1}/\text{value}_n$ for each year and check if this ratio is constant.
 4. list all data points where the new value is missing but not in the previous instance;
 5. list all data points where the old value is missing and not the new value;
 6. list all data points where the new value $< \text{average} - 3 * \text{std deviation}$;
 7. list all data points where the new value $> \text{average} + 3 * \text{std deviation}$;
 8. list indicators with unique value in time series;
 9. list indicators where the unit have changed between the previous delivery and the new update;
 10. list indicators where unit is missing but not the value;
 11. list missing or added indicators between the 2 updates;
 12. list of overruled data on the previous update, the value overruled and the new value.

Once all these checked files are validated, data are recorded on the final table which contains all data points (raw data and computed data). Where a data point fails one or more of the validation checks described above and no supporting evidence can be obtained from publicly available sources, the overrule procedure is applied. If no decision is made, questions are raised back to the provider for further investigation and justification.

An overrule is applied only in exceptional circumstances where a data point is identified as erroneous and its inclusion would result in an unjustified increase or decrease in a country's score. Following validation of the issue, the affected variable is replaced with the value reported in the most recent data refresh where the variable was considered reliable. Where no reliable historical value is available, the variable is assigned a null value. This process is intended solely to mitigate the impact of confirmed data errors on the scoring results and to ensure the consistency, comparability, and robustness of the methodology pending correction of the underlying data issue.

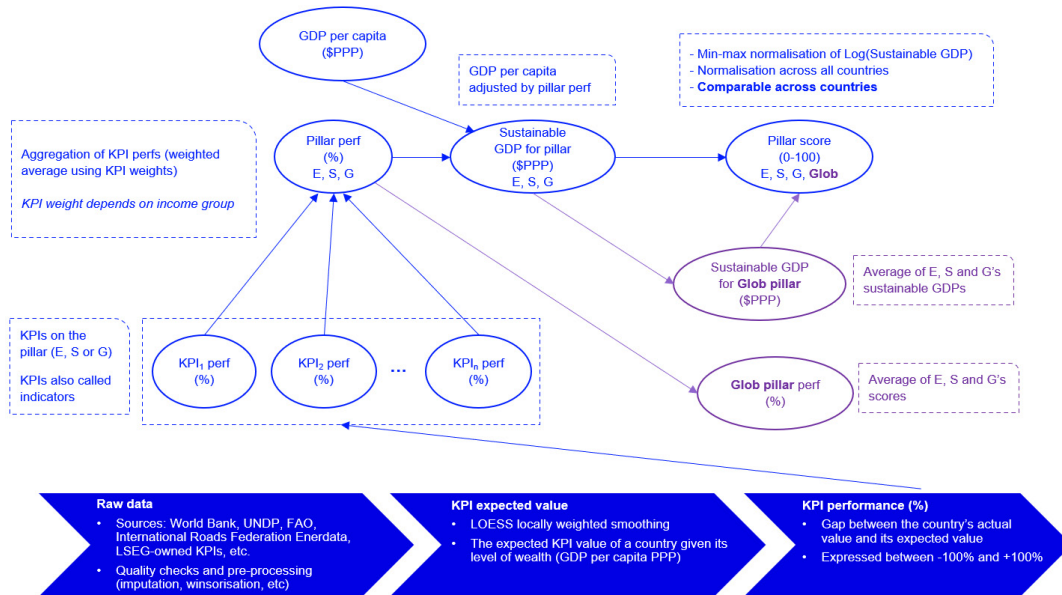
3.2 Data Limitations

The completeness for all year and all countries can't be reached, consequently, imputation of missing datapoints has to be done. Rules are:

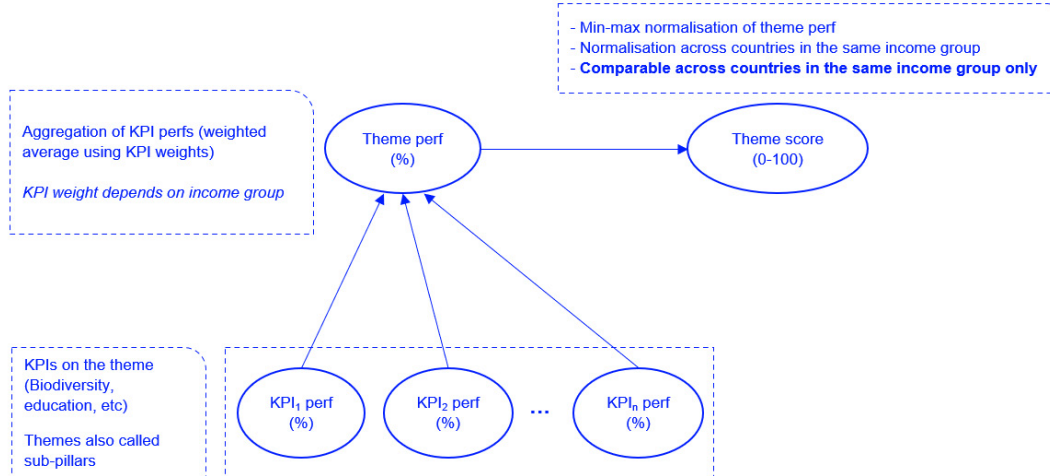
- For missing points at the beginning (resp. end) of a timeseries, datapoints are imputed as the first (resp. last) available datapoint.
- For missing datapoints in the middle of the timeseries, the estimation is performed with a linear regression with the closest available datapoints before and after the missing one
- For a completely missing timeseries, performance is set to 0 (country is supposed to have a value consistent with its wealth).

Appendix 1: Flow charts summarizing the methodology

1.1 From KPI to pillar



1.2 From KPI to theme



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