# Greenhouse Gas Emissions Methodologies

MSCI ESG Research LLC

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# Introduction

Rising concentration in greenhouse gases (GHGs) in the atmosphere due to anthropogenic activities has contributed significantly to detrimental climate change effects.[1] In order to reduce the negative impacts of climate change, world leaders in December 2015, through the Paris Agreement, decided to limit global warming this century to 2 degrees Celsius, compared with a pre-industrial period (1861-1880) benchmark, and to pursue efforts to limit the warming further to 1.5 degrees Celsius.[2] The Paris Agreement requires all member countries to reduce their greenhouse gas emissions (or carbon emissions[3]) and strengthen these efforts in the years ahead.

The Greenhouse Gas Protocol (GHGP) has set the global standard for emissions accounting for companies. It defines three emissions Scopes which form a complete picture of all emissions generated directly or indirectly by a company:

- Scope 1 emissions, which are emissions directly generated by the company.
- Scope 2 emissions, which are emissions from purchased or acquired electricity, steam, heating, and cooling.
- Scope 3 emissions, which represent value chain emissions (upstream and downstream) not accounted for in Scope 1 and Scope 2.

MSCI ESG Research's methodology follows the GHGP in including carbon dioxide ($CO_2$) and the five other principal GHGs: hydrofluorocarbons (HFCs), methane ($CH_4$), nitrous oxide ($N_2O$), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$). Emissions of these other gases are accounted for in terms of the quantity of $CO_2$ that has an equivalent global warming potential.

MSCI ESG Research collects reported emissions and uses proprietary estimation methodologies. Both are described in this document. The estimation methodologies follow the GHGP's accounting principles as closely as possible.

[1] "Summary for Policymakers. In: Climate Change 2023. Synthesis Report." IPCC, 2023. Accessed on Jun. 19, 2024, https://www.ipcc.ch/report/ar6/syr/

[2] The Paris Agreement. What is the Paris Agreement?" United Nations Climate Change. Accessed on Jun. 19, 2024, https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[3] Greenhouse gas emissions, GHG emissions and carbon emissions are used interchangeably. In this document, we have primarily used "carbon emissions" to denote greenhouse gas emissions.

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## Reported emissions

MSCI ESG Research collects carbon emissions data (Scope 1, Scope 2, and Scope 3) for companies in our coverage universe[4]. Data is collected once per year from most recent corporate sources, including annual reports, Corporate Social Responsibility reports and/or company websites. In addition, MSCI ESG Research uses carbon emissions data reported through CDP (formerly the Carbon Disclosure Project) when reported data is not available through direct company disclosures.

[4] Please also refer to the chapter "Coverage, data, and methodology updates" for more information on the coverage universe.

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## Scope 1+2 emissions estimation model

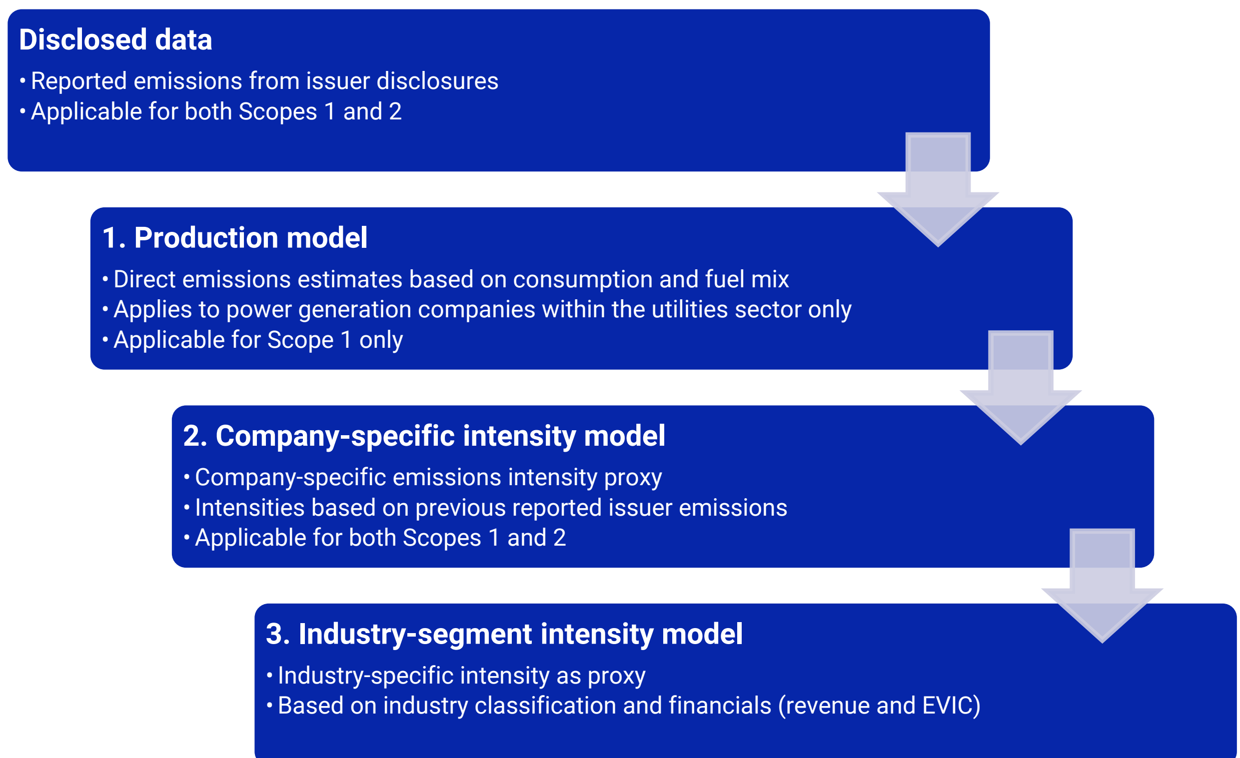
MSCI ESG Research estimates emissions if a company's reporting does not align with the GHGP framework or otherwise does not report its emissions according to common reporting standards. The same applies for companies that do not report Scope 1+2 carbon emissions data.

MSCI ESG Research estimates a company's carbon emissions using one of following three models in the given order of preference:

1. Production model
2. Company-specific intensity model
3. Industry segment-specific intensity model

The company-specific and industry segment-specific models use data disclosed by companies in our coverage (current and historical) to estimate carbon emissions intensity at the company level and at the industry segment level. Scope 1 and Scope 2 carbon emissions are separately estimated, which allows us to consider partly disclosed data (e.g. only Scope 1 or Scope 2) and use the most fitting model from the following hierarchy:

**Exhibit 1: Summary of approach for Scope 1 and 2 emissions estimations**

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## Production model

### Modeling steps

For power generating electric utilities, power generation fuel-mix data are used to estimate the carbon emissions due to its power generation activities as follows:

1. Collect reported data on total power generation by fuel type for the following fuels:
    - Coal
    - Liquid fuels
    - Natural gas
    - Nuclear power
    - Renewable energy
2. Estimate the Scope 1 carbon emissions: Apply appropriate carbon emissions factors to the fuel-mix data.[5]
3. For the parts of the business that are not part of a company's power generation activities or for those companies without power generation fuel-mix data, emissions are estimated using the industry segment-specific intensity model.

## Company-specific intensity model

### Modeling Steps

For companies that have reported carbon emissions data for some but not for all past relevant fiscal years, carbon emissions are estimated based on their historical reported emissions:

- Estimate company emissions intensities using the historical reported emissions and revenue data.
- Apply the current revenue to the company-specific carbon emission intensity to calculate the emissions of that year.

This model is not applied for companies that have undergone corporate actions (for example, mergers & acquisitions) even if such companies have reported data in the past and for companies that have not reported emissions for more than 5 years because the reported data may not represent the company's current operational characteristics.

## Industry segment-specific intensity model

For companies that have not reported any carbon emissions data in the past, the industry segment-specific intensity model is applied.

[5] U.S. Energy Information Administration (EIA) 2023, "FREQUENTLY ASKED QUESTIONS (FAQS). How much carbon dioxide is produced per kilowatthour of U.S. electricity generation?" Accessed on June 11, 2024

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**Modeling steps**

1. From the reported data set, estimate average carbon emissions intensity for 1,000+ industry segments using company-specific carbon emission intensities[6].
2. Apply these average intensities to each of the company's reported industry segments for the year in question and multiply each intensity figure by the relevant segment's revenue to calculate estimated emissions for each industry segment.
3. Sum the estimated emissions for each industry segment to calculate the company's total estimated carbon emissions for the year in question.

[6] Emission factors are assigned to sectors using Standard Industrial Classification (SIC) system

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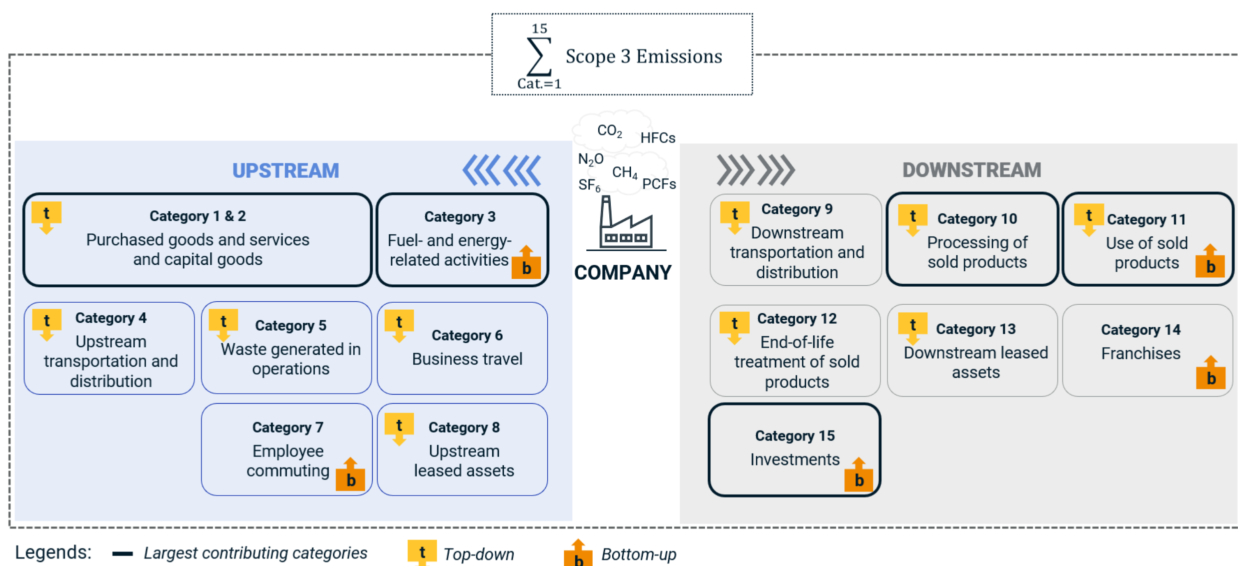
# Scope 3 emissions estimation model

Company reporting of Scope 3 emissions data is limited as of today. Even when Scope 3 data is reported, it is often incomplete, inconsistent and volatile. MSCI ESG Research's Scope 3 emissions estimation model attempts to address these challenges. The scope 3 estimation model is based on the GHGP's "Corporate Value Chain (Scope 3) Accounting and Reporting Standard", which divides Scope 3 emissions into 15 categories.[7]

Exhibit 7 shows the 15 different categories of Scope 3 emissions, divided into upstream and downstream emissions. Each Scope 3 category is unique and requires a different estimation methodology, though Categories 1 and 2 are estimated together due to data constraints.

**Exhibit 2: Distribution of upstream and downstream Scope 3 emissions categories and MSCI ESG Research approach for Scope 3 emissions estimations**




*Note: This schema is based on the GHGP Corporate Value Chain (Scope 3) Accounting and Reporting Standard (WRI and WBCSD 2011). Categories 1 and 2 have been merged as a single category for methodological reasons.*
*Source: MSCI ESG Research, as of June 2024*

Scope 3 emissions are estimated for each category separately (except for Categories 1 and 2 which are combined). The model generally follows two different modeling approaches:

- Bottom-up approach: Use company-specific information to estimate emissions;
- Top-down approach: Use the sectoral revenues of a company to estimate emissions.

Each category uses either a bottom-up or a top-down approach, except for Category 11. Here, a hybrid approach is possible if parts of a company's business can be covered by bottom-up data while others fall back to the top-down approach.

[7] Greenhouse Gas Protocol. 2011. "Corporate Value Chain (Scope 3) Accounting and Reporting Standard"

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## Bottom-up model

The **bottom-up approach** uses company-specific information, such as detailed production data, to estimate Scope 3 emissions. If input data is available, the bottom-up approach is used for Categories 3, 7, 11, 14 and 15. This approach requires sufficient data availability. If data are not available, MSCI ESG Research does not estimate emissions for this category. For category 11, Scope 3 emissions can be estimated using both the top-down and the bottom-up approaches. Since the bottom-up approach generally provides more granular insight, it takes precedence over the top-down approach.

### Modeling steps

1. Compute emission factors with the company-specific information
2. Multiply the relevant company-specific information with internally computed emissions factors matching that information.

**Exhibit 3: Example of an estimation of a company's employee commuting emissions (category 7)**

| Company's geographic coverage | Employees per country | Emission factor per employee ($tCO_2e$/employee/yr) | Emissions from employee commuting per country ($tCO_2e$/country/yr) |
|---|---|---|---|
| **Country A** | 1,000 | 0.311 | 311 |
| **Country B** | 500 | 0.236 | 118 |
| **Total Category 7 emissions ($tCO_2e$/yr)** | | | 50,987 |

*Source: MSCI ESG Research, as of June 2024*

## Top-down model

The **top-down approach** estimates a company's Scope 3 emissions by applying a pre-computed sector-specific emission factor (emissions per unit of revenue or other economic measures) to available company data. The emission factors are created by MSCI ESG Research and computed from various sources such as lifecycle databases, reported emissions, academic studies or by research performed by MSCI ESG Research.[8] They have different degree of granularity depending on the category. For all categories, the emission factors are by sector, and for categories 4 and 9, also by geographic region. If sufficient data are not available, these are computed by regression analysis of peer companies' Scope 3 disclosures. The output is a Scope 3 emissions estimate for a company segment that is relevant to the category. The top-down approach is used for Categories 1,2, 4-6 and 8-13.

[8] Where external sources are used, such as from academic and think tank organizations, all data and models are onboarded following MSCI ESG Research's vendor due diligence process.

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### Modeling steps

1. Compute Scope 3 emissions category- and sector-specific emission factors. These are internally-created sector systems that are tailored to the granularity that is required to model a category.
2. Multiply sector-specific revenues with sector-specific emissions factors.

**Exhibit 4: An example of top-down approach: Calculating Scope 3 emissions from Categories 1 & 2**

| Company A's sectors | Revenue (USD million/yr) | Emission factor ($tCO_2e$/USD million) | Sectoral emissions ($tCO_2e$/yr) = Revenue x Emission factor |
|---|---|---|---|
| **Oil and gas field exploration services** | 1,500 | 138.054 | 207,081 |
| **Thermal coal mining** | 2,000 | 216.749 | 433,498 |
| **Oil and gas extraction** | 280 | 182.097 | 50,987 |
| **Total Category 1 and Category 2 emissions ($tCO_2e$/yr)** | | | 691,566 |

*Source: MSCI ESG Research, as of June 2024*

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# Production-based intensities

In addition to Scope 1, Scope 2, and Scope 3 GHG emissions, MSCI ESG Research developed additional GHG metrics to assess and compare company carbon footprint. These additional metrics include emissions intensities, that is, emissions normalized by sales, enterprise value including cash (EVIC) or production data.

Standard setters and regulators have placed an increased focus on production-based GHG intensities, particularly for financial institutions: The Science Based Targets initiative (SBTi) recommends a sector-based approach for setting targets and tracking progress.[9] SBTi points out that the sector view enables financial institutions to manage their financed emissions with a focus on global carbon budgets. The European Banking Authority (EBA) requires financial institutions to compute production-based emissions intensities to create a more sector-specific view on the climate alignment of their portfolios.[10] This allows for tailored analysis of specific sectors, even if it comes at the expense of cross-sector comparability.

## Production-based intensities definition

Production-based intensities are computed by dividing emissions by a physical production amount.

$$Production\ intensity = \frac{Emissions}{Physical\ production\ amount}$$

**Emissions**
Scope 1, 2 and 3 production-based intensities are computed for energy, power and materials companies.

Scope 1 and 2 production-based intensities are computed for aviation companies.

Scope 3 Category 11 (Use-phase emissions, i.e. driving vehicles) production-based intensities are computed for manufacturers of passenger cars.

**Physical production amount**
For energy and power companies, the physical production amount usually refers to the energy extracted from fossil fuels or generated as electricity. For materials companies, it pertains to the volume of material produced, while for transportation companies, it relates to passenger-kilometers traveled. MSCI ESG Research's methodology is aligned with the physical production amount units provided in the EBA's Technical Standard.[11]

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[9] "Understand the methods for science-based climate action." Science-Based Targets Initiative (SBTi), Feb. 25, 2021.

[10] "Final draft implementing technical standards on prudential disclosures on ESG risks in accordance with Article 449a CRR." European Banking Authority, Jan. 24, 2022.

[11] "Implementing Technical Standards (ITS) on prudential disclosures on ESG risks in accordance with Article 449a CRR. Annex I - Templates for ESG prudential disclosures." European Banking Authority, Janu. 24, 2022.

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# Potential emissions

MSCI ESG Research provides estimations of potential emissions from fossil fuel reserves. For that reason, MSCI ESG Research provides reported fossil fuel reserves data in tons under the following reserve categories:[12]

1. Metallurgical coal
2. Thermal coal
3. Conventional oil
4. Shale oil
5. Oil shale & tar sands
6. Natural gas
7. Shale gas

## Modeling steps

1. To align with industry reporting practices, MSCI ESG Research collects company reported proved and probable reserves (2P) for coal, and proved reserves (1P) for oil and natural gas. 2P reserve values are considered for oil and natural gas, if a company does not disclose its 1P reserves.
2. To convert these reserves to potential emissions, the following formula is used from the Potsdam Institute for Climate Impact Research:[13]

   $$E = R \times V \times C \times f$$

   Where:

   - **E** : Potential emissions (MtCO2 = Megatons / Million tons of carbon dioxide),
   - **R** : Proven recoverable reserves (Gg = gigagrams),
   - **V** : Net calorific value of the fuel (TJ/Gg = terajoules per gigagram)
   - **C** : Carbon content of the fuel (tC/TJ = tons of carbon per terajoule)
   - **f** : a conversion factor (which is the ratio of the molecular weight of carbon dioxide to carbon)

[12] Please see MSCI ESG Research, “MSCI Fossil Fuels and Power Generation Metrics Methodology”, June 2024

[13] Meinshausen, Malte, Nicolai Meinshausen, William Hare, et al. "Greenhouse-Gas Emission Targets for Limiting Global Warming to 2°C." *Nature* 458 (2009): 1158–1162. https://doi.org/10.1038/nature08017.

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# Coverage, methodology, and data updates

## Coverage universe

The emissions coverage universe is determined by issuers' inclusion in the MSCI ESG Climate Change Metrics coverage universe. As of January 2024, this universe includes constituents of the MSCI ACWI Investable Markets Index (IMI) and constituents of selected other equity indexes [14] and fixed income issuers.[15]

## Data quality assurance

Internal Data quality assurance processes are conducted on all emissions data prior to publication.

## Methodology update processes

The ESG Methodology Committee (EMC) presides over the development, review, and approval of all MSCI ESG Research methodologies. Major methodology update proposals are subject to market consultation prior to approval for implementation by the EMC.

## Data update frequency

Emissions data are typically recalculated on a biweekly basis to reflect the most recent available company data. From the time company data is updated in internal databases, relevant changes are typically reflected in data distributed by MSCI ESG Research within two weeks. Prior to publication, additional quality assurance may be conducted, which can make the update cycle last up to 30 days or more.

Company data relevant to evaluations include new emissions figures, estimates, or sales/business segment information, and production data. Regular data update cycles are usually:

- Scope 1 and 2 data, reported Scope 3 emissions, and reserves data are updated throughout the year following the publication of companies' annual filings on a rolling schedule.
- Estimated Scope 3 emissions are typically recalculated on a biweekly basis on an update cycle of up to 30 days or more. The same applies for the aggregation to total emissions (sum of Scope 1, 2, and 3)
- Production data are collected or obtained from third-party databases, typically annually. Once available to MSCI ESG Research through collection or data load, the update can take up to 30 days or more to be completed.
- Potential emissions are updated when new reserves data are updated. Updates on emissions and target data in internal databases can take up to 90 days or more.

[14] Targeted equity indexes are: MSCI ACWI Investable Markets Index (IMI), MSCI China A International, MSCI Pakistan IMI, MSCI Argentina Standard, MSCI Domestic Kuwait, MSCI EFM AFRICA, MSCI Australia IMI+, MSCI New Zealand IMI+, MSCI Europe IMI+, MSCI UK IMI+.

[15] Corporate constituents of the Bloomberg Global Aggregate Index that meet our minimum disclosure threshold.

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