LOW CARBON TRANSITION RISK ASSESSMENT

MSCI ESG Research LLC

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Contents

Introduction

To reduce the negative impacts of climate change, in the December 2015 UN Paris Agreement ("the Paris Agreement"), world leaders set a goal to limit global warming to below 2°C above pre-industrial (1861-1880) levels, and to pursue efforts to limit warming to 1.5°C above pre-industrial levels.[1] The Paris Agreement requires all member countries to reduce their greenhouse gas emissions (or carbon emissions)[2] and strengthen these efforts in the years ahead.

In 2022, the "Emissions Gap Report" from the UN Environment Programme (UNEP) highlighted that since the 26th UN Climate Change Conference of the Parties (COP 26, 2021) insufficient progress has been made towards the emission reductions needed to limit global warming to 1.5°C. According to the report, "broad-based economy-wide transformations are required" to expedite the pace of low carbon transition and achieve a warming-level target of well below 2°C. [3,4]

In the event that the low carbon transition (the transition) takes place, demand for carbon-intensive products would decline in favor of low- and zero-carbon products, which would put carbon-intensive companies and industries (for example, coal-based power generation and coal mining) at risk of having stranded assets over the long term (5+ years). MSCI ESG Research considers a company exposed to low carbon transition risks and opportunities through two main transmission channels: (1) exposure through involvement in carbon-intensive operations, and (2) exposure through involvement in or solutions for carbon-intensive products.

Low Carbon Transition Risk assessment

MSCI ESG Research's Low Carbon Transition (LCT) Risk assesses companies' exposure to risks and opportunities related to the low carbon transition based on the carbon-intensive nature of their business lines. The time horizon for this assessment is considered to be long term (i.e. greater than 5 years). The assessment is derived from company disclosures and estimates.

The final output of this assessment is two company-level factors:

(1) Low Carbon Transition Category: This factor groups companies in five categories that highlight the predominant risks and opportunities they are most likely to face in the transition (see Exhibit 1).

(2) Low Carbon Transition Score: This score is based on a multidimensional risks and opportunities assessment, and considers both the primary risks (e.g., changes in market dynamics or regulations) and secondary risks (risks affecting the economy as a whole) a company faces from the transition.

[1] The Paris Agreement. 2015. United Nations. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[2] Greenhouse gas emissions, GHG emissions and carbon emissions are used interchangeably. In this document, MSCI ESG Research has primarily used "carbon emissions" to denote greenhouse gas emissions.

[3] Emissions Gap Report 2022. October 2022. United Nations Environment Program (UNEP). https://wedocs.unep.org/bitstream/handle/20.500.11822/40874/EGR2022.pdf?sequence=1&isAllowed=y

[4] The "low carbon transition" refers to the necessary transition of the global economy from carbon-intensive operations and energy sources to zero or low-carbon operations and energy sources.

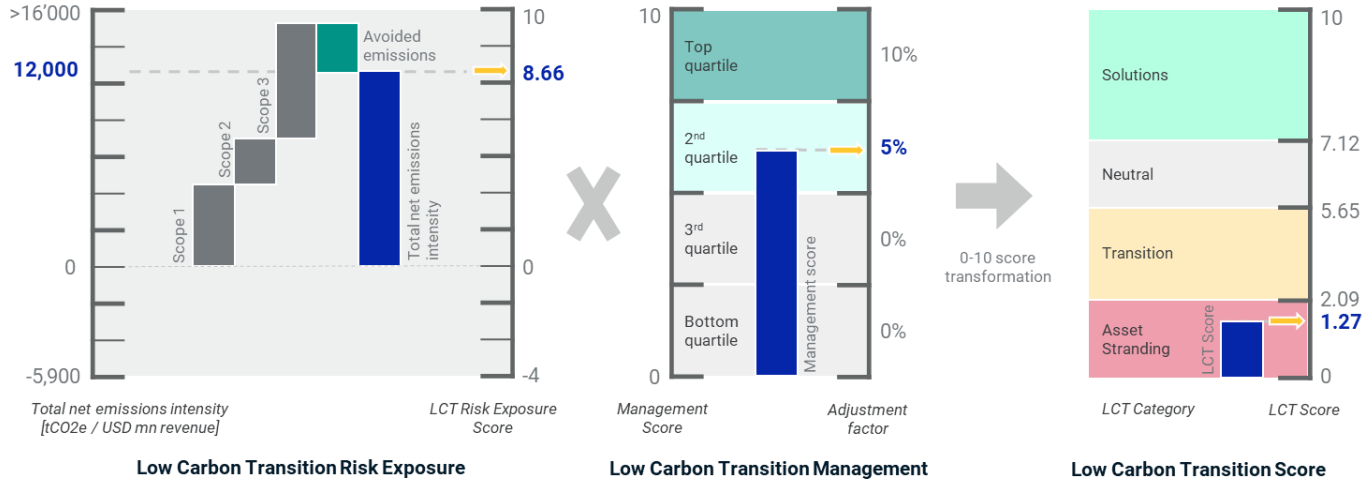
Exhibit 1: Low Carbon Transition Categories and Scores

LOW CARBON TRANSITION SCORE	LOW CARBON TRANSITION CATEGORY		LOW CARBON TRANSITION RISK / OPPORTUNITY	INDUSTRY EXAMPLES
SCORE = 0	ASSET STRANDING		Potential to experience "stranding" of physical / natural assets due to regulatory, market, or technological forces arising from low carbon transition.	Coal mining & coal-based power generation; industries in the Oil & Gas value chain
	TRANSITION	PRODUCT	Reduced demand for carbon-intensive products and services. Leaders and laggards are defined by the ability to shift product portfolio to low-carbon products.	Petrol/diesel-based automobile manufacturers
		OPERATIONAL	Increased operational and/or capital cost due to carbon taxes and/or investment in carbon emission mitigation measures leading to lower profitability of the companies.	Cement, Steel
	NEUTRAL		Limited exposure to low carbon transition carbon risk. Though companies in this category could have exposure to physical risk and/or indirect exposure to low carbon transition risk via lending, investment etc.	Consumer Staples, Healthcare
SCORE = 10	SOLUTIONS		Potential to benefit through the growth of low-carbon products and services.	Renewable electricity, Electric vehicles, Solar cell manufacturers

Methodology

The Low Carbon Transition Categories and Scores are determined by a combination of each company's current risk exposure and its efforts to manage the risks and opportunities presented by the low carbon transition (see Exhibit 2).

Exhibit 2: A three-step process to determine Low Carbon Transition Categories and Scores



Source: MSCI ESG Research. See Appendix 4 for more detail on above calculation.

Step 1: Measure Low Carbon Transition Risk Exposure

A company may be exposed to low carbon transition risks and opportunities through multiple risk transmission channels, as described below. A company's aggregate exposure through these channels informs its level of exposure.

Risk transmission channel: operations

A. **Direct operations:** Companies with carbon-intensive operations, such as coal-based power generation and cement production, could be exposed to climate transition costs through regulatory fines, carbon taxes, and required capital investments to reduce emissions.

   MSCI ESG Research uses Scope 1+2 carbon emissions intensity (tCO2e / USD million revenue) to measure the climate transition risk associated with companies' direct operations. In the absence of company-reported data, MSCI ESG Research uses carbon emissions estimates. Estimated emission intensities are derived from two possible approaches: (1) by company-specific emission intensities based on previously disclosed company data, or (2) by industry-specific emission intensities applied to a company's business activities. For power generating companies, estimates are based on disclosed fuel mix and the emission intensities of each fuel type.

B. **Supply chain:** Companies with carbon-intensive supply chains could be exposed to rising raw material costs or supply disruptions caused by any carbon-related operational risk in the supply chain.

   MSCI ESG Research uses estimated Scope 3 upstream carbon emission intensity to measure risk exposure through this channel. MSCI ESG Research computes these estimates based on MSCI ESG Research's proprietary carbon estimation methodology[5], which

[5] "Scope 3 Carbon Emissions Estimation Methodology", MSCI ESG Research LLC.

estimates emission intensities for each Scope 3 upstream category individually using a top-down (revenue-based) or bottom-up (based on operational data) approach.

Risk transmission channel: products

C. **Carbon-intensive products:** Companies with carbon-intensive products (e.g., petrol/diesel-based automobiles and fossil fuels) and companies in carbon-dependent industries (defined as those with high revenue dependence on companies with carbon-intensive operations or products, e.g., energy equipment and services and steam turbine manufacturers) may face reduced demand for their products and services as a result of a low carbon transition.

   MSCI ESG Research uses estimated Scope 3 downstream carbon emission intensity to measure risk exposure to these types of products. MSCI ESG Research computes these estimates based on MSCI ESG Research's proprietary carbon estimation methodology.[5]

D. **Low- or zero-carbon products:** Companies involved in low- or zero-carbon products (e.g., renewable energy production and energy efficient equipment) are likely to benefit from an increase in demand for products and services that provide solutions to address climate change.

   MSCI ESG Research uses estimated avoided carbon emission intensity to measure risk exposure through this channel. MSCI ESG Research estimates avoided carbon emissions for companies involved in **alternative energy** and **energy efficient** technologies. Please refer to Appendix 1 for detailed information on the products and services covered under these two categories and Appendix 2 for more details on the avoided emissions estimation methodology.

See Appendix 3 for definitions of each of the metrics used to measure exposure through these channels. All carbon emission intensities are measured as tons of CO2 equivalent (tCO2e) per USD million revenue.

A company's Low Carbon Transition Risk Exposure is calculated based on its estimated total net carbon intensity, which considers operational and product carbon emissions.

Once the total net carbon intensity of a company is calculated, its Low Carbon Transition Risk Exposure Score is computed.

Adjustment for companies with operations in the fossil fuel value chain

MSCI ESG Research adjusts the Low Carbon Transition Risk Exposure Score for companies that have operations in the fossil fuel value chain. MSCI ESG Research's Scope 3 estimation methodology is aligned with the Greenhouse Gas Protocol (GHGP), which does not require service providers in the fossil fuel value chain to report emissions associated with the use of fossil fuel products (Scope 3, Category 11). As a result, GHGP-aligned emissions from fossil fuel related service providers (e.g., refining, transportation, distribution, and other services) do not fully reflect the transition risks faced by companies in the fossil fuel value chain.

To reflect the transition risks of companies involved in the fossil fuel value chain, MSCI ESG Research adjusts the LCT Risk Exposure Score to account for revenue[6] associated with the oil and gas and coal industries. For a company that operates in the oil and gas value chain, the portion of revenue that is associated with this industry is adjusted using the average LCT Risk Exposure Score of the Oil & Gas Exploration and Production Global Industry Classification Standard (GICS®)[7] sub-industry. The same is done for companies with operations in the thermal coal value chain. The LCT Risk Exposure Score formula is shown below:

$$\begin{aligned}\text{LCT Risk Exposure Score}_{\text{final}} = \quad & [\text{O\&G revenue \%}] \cdot [\text{O\&G Producer LCT Risk Exposure Score}] \\ & + [\text{Coal revenue \%}] \cdot [\text{Coal Miner LCT Risk Exposure Score}] \\ & + ([1 - [\text{O\&G revenue \%}] - [\text{Coal revenue \%}]) \\ & \qquad \cdot \text{LCT Risk Exposure Score}_{\text{unadjusted}}\end{aligned}$$

For more details about the fossil fuel adjustment of LCT Risk Exposure Scores see Appendix 4.

Step 2: Assess Low Carbon Transition Risk Management

In the second step, MSCI ESG Research assesses a company's management of risks and opportunities presented by the low carbon transition. This assessment is based on policies and commitments to mitigate transition risk, governance structures, risk management programs and initiatives, targets and performance, and involvement in any controversies.

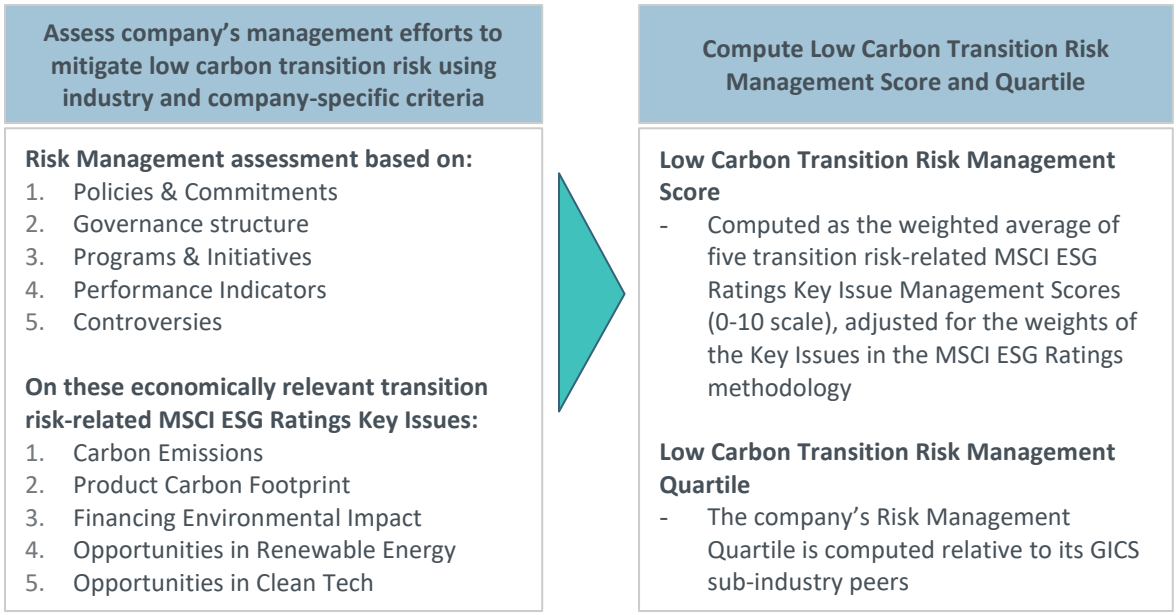
MSCI ESG Ratings measures these factors through adopting the assessments of five MSCI ESG Ratings Key Issues[8] (see Exhibit 3). Because low carbon transition risk manifests in different ways for different industries, each industry is assessed on the issues determined to be most economically relevant by the MSCI ESG Ratings assessment. For example, carbon-intensive industries such as electric utilities, steel and cement are analyzed on the management of potential transition risks due to their high direct carbon emissions (Scope 1+2) via the Carbon Emissions Key Issue, but automobile manufacturers are assessed on the carbon efficiency of their products (Scope 3 downstream) rather than their own emissions (Scope 1+2) via the Product Carbon Footprint Key Issue.

[6] In oil and gas related revenues, MSCI ESG Research includes revenues related to the following activities: equipment and services, exploration and production, distribution and retail, pipelines, refining, and trading. In coal related revenues, MSCI ESG Research includes revenues associated with thermal coal mining and coal mining services.

[7] GICS is the global industry classification standard jointly developed by MSCI and S&P Global Market Intelligence.

[8] MSCI ESG Ratings provide an opinion of companies' management of financial relevant ESG risks and opportunities. These ESG risks and opportunities are called Key Issues. Each Key Issue takes into consideration companies' exposure to the potentially material ESG risks, and the quality of companies' management systems and governance structures to mitigate such risks (Management Scores). Please refer to "ESG Ratings Methodology" for more details on how Key Issues are selected and weighted in the ESG Ratings methodology > https://www.msci.com/esg-and-climate-methodologies.

Exhibit 3: Compute Low Carbon Transition Risk Management Score and Quartile



Computation of the Low Carbon Transition Risk Management Score and Quartile for a company is explained in Exhibit 3. Please refer to Appendix 4 for more details on the underlying calculation steps.

Step 3: Calculate Low Carbon Transition Category and Score

In the final step, the Low Carbon Transition Risk Exposure Score that was calculated in Step 1 is adjusted by the company's Low Carbon Transition Management Score. The Low Carbon Transition Risk Exposure Scores of companies with first or second quartile risk management are adjusted downwards by 10% and 5%, respectively (see Exhibit 2). Following this adjustment, some first and second quartile companies may move up one category. The final output is a Low Carbon Transition Score on a 0-10 scale that corresponds to Low Carbon Transition Category. Please refer to Appendix 4 for more details on the underlying calculation steps.

Process and governance

The Low Carbon Transition Assessment is a derived assessment that aggregates collected data and outputs from several primary MSCI ESG Research methodologies. The Low Carbon Transition Categories and Scores are generally updated quarterly.

Entity Selection & Data Mapping

ESG Evaluations, including LCT assessments may be attributed to related companies. Companies are selected for ESG Evaluations through MSCI ESG Research's Entity Selection process – these are known as Data Entities. Assessments are attributed to related companies through a MSCI ESG Research's Data Mapping process.

Data Entities

MSCI ESG Research defines a Data Entity as an entity subject to an ESG Evaluation. To determine which entity or entities within a group of related companies should be evaluated for a given assessment, MSCI ESG Research conducts a review of the companies' financing structures.

Evaluation Boundary

Where there are multiple LCT assessments within a group of companies, the LCT Evaluation Boundary may overlap, or a set of LCT evaluations may be nested inside another, particularly where one of the companies is an equity issuer.

For LCT:

- The Evaluation Boundary for an equity issuer is the whole group of companies.
- The Evaluation Boundary for a bond issuer that sits within a group but is financing only a discrete part of the group (e.g. a single business line or division, specific operating company, the captive finance activities, etc.) extends only to that part of the group. Any activity involvement identified for this discrete part of the group will also be reflected in the group's evaluation.

Data Mapping

Data Mapping is the process whereby ESG Evaluations for a company (a Data Entity) are attributed to related companies. ESG Evaluations are mapped based on observed parent-subsidiary relationships, subject to certain company and data point requirements.

- Certain companies (such as those classified as financing companies) included in the coverage universe may be covered by data mapping from the relevant Data Entity.
- Bond issuers outside the LCT coverage universe may also have their evaluations mapped from parent entities that are included in the LCT coverage universe.

Note that LCT assessments are not to be mapped to:

- Equity issuers; or
- Companies that have already been assessed by MSCI ESG Research.

MSCI ESG Research does not recommend the use of Data Mapping for the following assessment types:

- Ownership Of; and
- Ownership By.

Ongoing monitoring and update cycle

Minimum data requirements to calculate a Low Carbon Transition Score

The following data points are required to calculate and maintain a Low Carbon Transition Score:

- Reported or estimated Scope 1 and 2 emission intensity,[9]
- Estimated Scope 3 upstream and downstream emission intensity,[10]
- Alternative energy and energy efficiency revenue percentage,[11]
- At least one of the relevant Key Issue Management Scores.[12]

Ongoing updates of data and estimates

Company disclosures:

Generally, underlying data (i.e., carbon emissions, alternative energy revenue, energy efficiency revenue) is updated according to the disclosure cycles of companies on an annual basis.

Estimated input data sets:

Low Carbon Transition Scores and Categories use multiple calculated data sets as inputs that follow different update cycles. The timing and frequency of these data sets is detailed below:

Data set	**Publication cycle[13]**
Estimated Scope 1+2 carbon emission intensity	Estimates for companies that do not report Scope 1+2 emissions are typically published up to semi-annually depending on the estimation approach.[9]
Estimated Scope 3 carbon emission intensity	Typically, updated estimates based on changes in revenue data are published bi-weekly. Other data and model updates are typically published monthly.[10]
Key Issue Management Scores for five Key Issues	The Carbon Emissions Management Score is generally updated annually to account for new disclosures. The timing of this update is independent of the ESG Rating review and rating action.[9] Other Key Issue Management Scores are generally updated annually at the time of the ESG Rating review and rating action.[12]

Data quality assurance:

Input data is subject to quality assurance processes. This includes automated checks and review by ESG Data Experts and ESG Analytical Personnel when required.

[9] For details, please refer to "MSCI ESG Climate Change Metrics: Methodology and definitions", MSCI ESG Research LLC.

[10] For details, please refer to "Scope 3 Carbon Emissions Methodology", MSCI ESG Research LLC.

[11] For details, please refer to "MSCI Sustainable Impact Metrics: Methodology", MSCI ESG Research LLC.

[12] See a list of the relevant Key Issues in Exhibit 3. For details about the underlying methodology, please refer to "ESG Ratings Methodology", MSCI ESG Research LLC.

[13] Not considering ad-hoc publications.

Criteria for an *ad-hoc* update to Low Carbon Transition Scores

MSCI ESG Research follows specific criteria to determine whether an event such as a corporate action or significant change in data warrants a mid-cycle re-assessment of a company's Low Carbon Transition Score, including the following:

- Low Carbon Transition Risk Management Quartile change of at least two quartiles
- New information provided by a company that results in one of the following:
    - More than 25% increase/decrease in carbon emissions intensity.
    - Change of at least 2 points on the Low Carbon Transition Risk Management Score (on a 0-10 scale).
    - More than 10 percentage points increase/decrease in alternative energy and energy efficiency revenue.
    - Change in business segment data that results in a change of the company's Low Carbon Transition Category.
- A significant corporate action that results in a change to the historical carbon emissions data and intensity or a change of at least 2 points on the Low Carbon Transition Risk Management Score (on a 0-10 scale).

Corporate actions and related changes

The coverage universe may change due to changes in coverage initiated by MSCI ESG Research and due to changes in index constituents, which are periodically rebalanced by the index administrator.

New additions to the issuer coverage universe:

MSCI ESG Research aims to assess additions to the MSCI World Index, MSCI Emerging Markets Index, MSCI China A Index and MSCI US IMI within one quarter of their inclusion in the relevant index. MSCI ESG Research aims to assess additions to any other indexes in the ESG Ratings coverage universe within two quarters of index inclusion.

Spin-offs:

If a new entity is a constituent of the MSCI World Index, MSCI Emerging Markets Index, MSCI China A Index or MSCI US Investible Market Index (IMI), MSCI ESG Research aims to assess it as a standalone entity within one quarter.

If the spun-off entity is in the targeted issuer universe, but is not a constituent of the MSCI World Index, MSCI Emerging Markets Index, MSCI China A Index or MSCI US IMI, MSCI ESG Research aims to assess it as a standalone entity within two quarters.

Acquisitions:

If an acquiring company does not have an existing assessment, even if the acquired entity has an existing assessment, the acquiring company is considered a "new" entity and will be assessed according to the index addition approach stated above.

If an acquiring company has an existing assessment, the acquiring company's assessment will consider the newly acquired entity at the time of the next annual update for the acquiring company. The assessment of both companies will remain available until the reassessment.

Mergers:

If a merger creates a new entity, it will be researched according to the issuer universe addition approach stated above.

Global Industry Classification Standard (GICS®)[14] sub-industry classification change:

If a company's GICS sub-industry classification changes, the effects of the change on the Low Carbon Transition model will be reviewed within one quarter of the GICS sub-industry classification change following the regular timing of the Low Carbon Transition model releases.

Deletions to indexes in the coverage universe:

When a company is removed from the coverage universe – for example, due to turnover in index constituents or due to corporate actions – the company's Low Carbon Transition Risk Assessment will no longer be updated, and its Low Carbon Transition Category and Score and other data points will be removed from the MSCI One platform typically the following month, and from data feeds at the next scheduled data feed delivery.

Methodology update processes

The ESG Methodology Committee (EMC) presides over the development, review and approval of all MSCI ESG Research methodologies. Prior to approval for implementation by the EMC, MSCI ESG Research may invite feedback from investor clients and/or rated corporate entities through a consultation process.

[14] GICS is the global industry classification standard jointly developed by MSCI and S&P Global Market Intelligence. "Global Industry Classification Standard (GICS®) is a service mark of MSCI and S&P Global Market Intelligence.

Appendix 1: Products and services covered under Alternative Energy and Energy Efficiency

MSCI ESG Research estimates avoided carbon emissions for companies involved in alternative energy and energy efficient technologies. Below, MSCI ESG Research lists the products and services covered under the respective categories.

Alternative Energy

This category includes products, services or infrastructure projects supporting the development or delivery of renewable energy and alternative fuels, including:

- Generation, transmission and distribution of electricity from renewable sources including wind, solar, geothermal, biomass, small scale hydro (<25 MW), waste-to-energy, and wave tidal.
- Fuels, technology and infrastructure for the production and distribution of cleaner hybrid fuels, fuel cells and alternative fuels, including biodiesel, biogas and cellulosic ethanol.
- Natural gas-powered combined heat and power.
- Batteries and energy storage technologies that support alternative energy.

MSCI ESG Research's alternative energy category does not include:

- Large scale hydroelectric plants (>25 MW installed capacity).

Energy Efficiency

This category includes products, services, infrastructure or technologies that proactively address the growing global demand for energy while minimizing effects on the environment, including:

- Technologies and systems that promote the energy efficiency of industrial operations (e.g., turbines, motors and engines), business operations (e.g., telepresence services) and IT systems (e.g., cloud computing infrastructure and platform services, virtualization and data center optimization).
- Infrastructure, technology and systems that increase the efficiency of power management, power distribution and demand-side management (e.g., wireless sensors, advanced meters, smart grid).
- Technologies and systems focused on reducing fuel consumption of transport vehicles and industrial operations (e.g., hybrid/electric vehicles).
- Sustainable transportation infrastructure including urban mass transit, efficiency improvements of public transportation fleets, electric vehicle charging and improved traffic systems.
- Architectural glass, energy efficient lighting, insulation, building automation and controls, and devices and systems designed to be utilized in the design and construction of environmentally sustainable buildings.

MSCI ESG Research's Energy Efficiency category does not include:

- Corporate operational energy efficiency efforts, such as efficiency gains in manufacturing, transporting or distributing standard products or services.
- Energy-efficient components of finished goods.
- Energy-efficient consumer devices (e.g., electronics) and appliances (e.g., refrigerators).
- Cloud computing services or technologies that do not have notable energy efficiency benefits.
- Building and industrial automation technologies that do not have notable energy efficiency benefits.

Appendix 2: Avoided Emissions Estimation Methodology

Low-emission products, technologies and services can lead to reduced emissions outside of their life cycle or value chain due to the decreased use of more carbon-intensive alternatives. Such reduced emissions are called avoided emissions. Examples of products and services that avoid emissions include low-temperature detergents, renewable electricity, energy-efficient ball bearings, and teleconferencing services.

The avoided carbon emission intensity for a company involved in cleaner products, technology or services is estimated as follows:

$$\textbf{Avoided carbon emission intensity } [\textbf{tCO}_2\textbf{e / USD million}]$$
$$= \text{production volume of cleaner technology [production volume]}$$
$$\cdot \text{ carbon emission intensity of avoided technology } [\text{tCO}_2\text{e / production volume}]$$
$$/ \text{ revenue [USD million]}$$

Please note that this estimation approach implicitly assumes that the avoided technology is replaced by an equal production volume of the cleaner technology and that the clean technology is carbon neutral.

Based on the approach outlined above, MSCI ESG Research derived the following avoided emission intensities for all alternative energy and energy efficiency technologies:

Type of technology	**Avoided emission intensity [tCO2e / USD million revenue]**
Alternative energy	5,915
Energy efficiency	1,193[15]

[15] Within the category of energy efficiency products and services, hybrid electric vehicles are a major emerging technology (See Appendix 1). Hybrid electric vehicles avoid the use of conventional fossil fuels. Thus, MSCI ESG Research approximated avoided emissions intensity for hybrid vehicle manufacturers as the Scope 3 downstream emissions intensity for automobile manufacturers, which is estimated at 1,193 tCO2 per USD million. Currently, as an approximation, MSCI ESG Research applied the same intensity factor (1,193 tCO2 per USD million) to all energy efficiency technologies (see Appendix 1).

Appendix 3: Carbon intensity metrics for risk transmission channels

Risk Transmission Channel	Carbon Intensity Metric (tCO2e/USD million revenue)	Metric Definition
Operations: Own Operations	Scope 1+2 Carbon Emissions Intensity (reported or estimated)[16]	Scope 1 carbon (or carbon equivalent) emissions are direct carbon emissions that occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc. Scope 2 emissions are carbon emissions from the generation of purchased electricity consumed by the company. (Source: GHG Protocol)[17]
Operations: Upstream Supply Chain	Scope 3 Upstream Carbon Emissions Intensity (estimated)[5]	Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Scope 3 emissions occurring upstream of a company's operations are called Scope 3 upstream emissions. Some examples of Scope 3 upstream emissions are extraction and production of purchased materials, and transportation of purchased fuels. (Source: GHG Protocol)
Products: Carbon-intensive Products	Scope 3 Downstream Carbon Emissions Intensity (estimated)[5]	Scope 3 emissions are a consequence of the activities of the company but occur from sources not owned or controlled by the company. Scope 3 emissions occurring downstream of a company's operations are called Scope 3 downstream emissions. Some examples of Scope 3 downstream emissions are: use of sold products and services and end-of-life treatment of sold products. (Source: GHG Protocol)
Products: Low/zero Carbon Products	Avoided Carbon Emissions Intensity (estimated)[18]	Avoided emissions are emission reductions that occur outside of a product's life cycle or value chain, but as a result of the use of that product. Examples of products (goods and services) that avoid emissions include low-temperature detergents, renewable electricity, energy-efficient ball bearings and teleconferencing services. (Source: World Resource Institute)[19]

[16] Where companies do not report this information, MSCI ESG Research provides estimates based on our proprietary carbon estimation methodology.

[17] GHG Protocol; https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf.

[18] Please refer to Appendix 2 for more details on Avoided emissions estimation methodology.

[19] World Resource Institute; https://www.wri.org/blog/2013/11/do-we-need-standard-calculate-avoided-emissions.

Appendix 4: Low Carbon Transition Category and Score: calculation steps

MSCI ESG Research follows a three-step process to compute the Low Carbon Transition Category and Score.

Step 1: Measure Low Carbon Transition Risk Exposure

In this step, MSCI ESG Research computes two factors:

1. Low Carbon Transition Risk Exposure Category.
2. Low Carbon Transition Risk Exposure Score.

In order to compute the Low Carbon Transition Risk Exposure Score from total net carbon intensity, MSCI ESG Research uses following calculation steps:

1. Compute the standard deviation of the total net carbon intensity values distribution in the MSCI ACWI Investable Market Index (IMI).
2. Use the standard deviation to compute a scaling factor that ensures that the correspondence between any emission intensity and a Low Carbon Transition Risk Exposure Score is constant and does not depend on the standard deviation (0 and 16'000 tCO2e / USD million revenue correspond to scores of 0 and 10, respectively).
3. For all companies in the universe, MSCI ESG Research computes an emission intensity Raw Score given the total net carbon emission intensity x_i as follows:

$$\text{Raw Score}_i = \frac{|x_i|}{x_i} \cdot \sqrt{\frac{|x_i|}{\sigma_{\text{ACWI IMI}}}}$$

   Where:

   - x_i is the total net carbon intensity of company i
   - $\sigma_{\text{ACWI IMI}}$ is the standard deviation of net carbon intensities of companies in the MSCI ACWI IMI.

4. Compute the LCT Risk Exposure Score (unconstrained scale) from the Raw Score using linear interpolation between adjusted Z scores of 0 and the scaling factor calculated in step 2, which are assigned LCT Risk Exposure Scores of 0 and 10, respectively.
5. For companies with fossil fuel exposure,[20] adjust the LCT Risk Exposure Score using average LCT Risk Exposure Scores[21] of oil and gas as well as coal producers as follows:

[20] For companies with fossil fuel exposure, MSCI ESG Research considers companies that have revenues related to the following activities: O&G equipment and services, O&G exploration and production, O&G distribution and retail, O&G pipelines, O&G refining, O&G trading, thermal coal mining, and coal mining services.

[21] To calculate the average LCT Risk Exposure Score of oil and gas producers and coal miners, respectively, MSCI ESG Research first identify the companies to consider in the average. For oil and gas production, MSCI ESG Research select the companies assigned to the Oil and Gas Exploration and Production GICS sub-industry®. For coal mining, MSCI ESG Research select companies with at least 60% of revenues from thermal coal mining. Next, MSCI ESG Research calculates the average of the LCT Risk Exposure

$$\begin{aligned}\text{LCT Risk Exposure Score}_{\text{adj.}} = \quad & [\text{O\&G revenue \%}] \cdot [\text{O\&G Producer LCT Risk Exposure Score}] \\ & + [\text{Coal revenue \%}] \cdot [\text{Coal Miner LCT Risk Exposure Score}] \\ & + ([1 - [\text{O\&G revenue \%}] - [\text{Coal revenue \%}]) \\ & \qquad \cdot \text{LCT Risk Exposure Score}_{\text{unadjusted}}\end{aligned}$$

6. In the final step, truncate any LCT Risk Exposure Score value above 10 to 10 and below -4 to -4.

The rules for computing Low Carbon Transition Risk Exposure Categories from total carbon intensity, operational carbon intensity, and product carbon intensity are described in Exhibit A4.1. Companies can have a total net emission intensity that is larger than 8,000 tCO2e / USD million revenue and not be at risk of asset stranding. For example, companies involved in cement and steel production have high emission intensities but face a lower risk of asset stranding than companies involved in fossil fuel production because their products do not have a currently viable, low emissions alternative. To account for this, a company can only be classified as Asset Stranding if its emission intensity exceeds 8,000 tCO2e / USD million revenue and if it operates in the fossil fuel value chain.[22]

Exhibit A4.1: Determination of Low Carbon Transition Risk Exposure Category

Total net carbon intensity[23]	**Comment**	**Low Carbon Transition Risk Exposure Category**
If total carbon emissions intensity <0	Companies involved in low/zero carbon solutions would have negative total carbon intensity. Likely to	Solutions

Score of these oil and gas producers and coal miners, respectively. Companies contributing to the averages (producers) are excluded from the fossil fuel adjustment. To reduce volatility in the Low Carbon Transition Scores and Categories the average LCT Risk Exposure Scores are reviewed every three years. Current LCT Risk Exposure Score averages for fossil fuel production are calibrated based on data published as of July 2022.

[22] MSCI ESG Research consider a company to operate in the fossil fuel value chain if one or both of the following conditions apply:

- The company has fossil fuel related revenues: This includes revenues related to the following activities: O&G equipment and services, O&G exploration and production, O&G distribution and retail, O&G pipelines, O&G refining, O&G trading, thermal coal mining, and coal mining services.
- If the company is classified under the Utilities or Energy GICS sector or the Heavy Electrical Equipment sub-industry.

[23] As of January 2019. Total carbon emissions intensity thresholds are selected by a team comprised of industry experts and carbon experts and are reviewed and approved by the ESG Methodology Committee, which is comprised of senior ESG research leadership. These thresholds are defined after assessing the distribution of total carbon emissions intensity for companies within an industry and across industries. These thresholds are typically subject to regular annual or more frequent review. As a result of review the process, these thresholds may change.

	benefit in a low carbon scenario.	
If total carbon emissions intensity >=0, <700	Companies with less carbon-intensive operations and products. Likely to get less affected by a low carbon transition.	Neutral
If total carbon emissions intensity >=700, <8,000 and If Scope 3 downstream emission intensity >= Scope 1 and 2 emission intensity	Companies with moderately to highly carbon-intensive products. Such companies' products could go under transition in a low carbon scenario.	Product Transition
>=700, <8,000 and If Scope 1 and 2 emission intensity > Scope 3 downstream emission intensity	Companies with moderately to highly carbon-intensive operations. Such companies' operations could go under transition in a low carbon scenario.	Operational Transition
If total carbon emissions intensity >=8,000 and If company operates in the fossil fuel value chain[22]	Outlier transition companies with very high exposure to transition risk. May face asset stranding risk in the short- to medium-term.	Asset Stranding

Exhibit A4.2: Total carbon intensity, Low Carbon Transition Risk Exposure Category and Low Carbon Transition Risk Exposure Score equivalence

Total Carbon Emissions Intensity	Low Carbon Transition Risk Exposure Category	Low Carbon Transition Risk Exposure Score
<0	Solutions	-4 to 0
>=0, <700	Neutral	0 to 2.09

>=700, <8,000	Transition (Operational or Product[24])	2.09 to 7.07
>=8,000	Asset Stranding	7.07 to 10

Step 2: Assess Low Carbon Transition Risk Management

Our assessment of a company's low carbon transition risk management efforts is based on its policies and commitments to mitigate transition risk, governance, risk management programs and initiatives, targets and performance, and controversies assessment on five MSCI ESG Ratings Key Issues ("Key Issue", see Exhibit A4.3).

Computation of the Low Carbon Transition Risk Management Score for a company is based on the following data points:

1. Management Scores for five Key Issues (see Exhibit A4.3).
2. Key Issue weights for five Key Issues.

The Low Carbon Transition Risk Management Score for a company is computed as the weighted average of the Key Issue management scores (of five Key Issues),[25] using the following formula:

$$\textbf{Low Carbon Transition Risk Management Score} = \sum(\text{Key Issue Management Score}_i \cdot \text{Key Issue Weight}_i) \,/\, \sum \text{Key Issue Weights}_i$$

This yields scores of 0-10, where 0 represents worst-in-class risk management and 10 represents best-in-class risk management within a given GICS sub-industry. Once MSCI ESG Research has the Low Carbon Transition Risk Management Score, MSCI ESG Research computes Low Carbon Transition Risk Management Quartile for each company relative to its GICS sub-industry peers.

[24] Within the Transition Category, a company will be classified as Operational Transition if its Scope 1 and 2 emissions intensity is larger than in its Scope 3 downstream emission intensity. If its Scope 3 downstream emission intensity is larger than its Scope 1 and 2 emission intensity, the company is classified as Product Transition.

[25] If a company is not assessed on any of these five Key Issues, then its Carbon Emissions Risk Management Score is used as the Transition Risk Management Score. MSCI ESG Research conducts the Carbon Emissions Key Issue assessment for all companies in the coverage universe of Climate Change Metrics irrespective of whether it is a Key Issue for the company or not.

Exhibit A4.3: Description of low carbon transition-related MSCI ESG Ratings Key Issues

Key Issue	Intent	Management Metrics
Carbon Emissions	This Key Issue evaluates the extent to which companies may face increased costs linked to carbon pricing or regulatory caps due to their high Scope 1+2 carbon emissions.	Efforts to reduce exposure through comprehensive carbon policies and implementation mechanisms, including carbon reduction targets, production process improvements, and installation of depollution or emissions capture equipment, and/or switch to cleaner energy sources.
Product Carbon Footprint	This Key Issue evaluates the extent to which companies (1) may face higher input or production costs for high-embedded carbon emissions products (e.g., steel products, agriculture, and meat products, etc.) and/or (2) may face increased costs and/or decreased demand for their products due to their involvement in manufacturing carbon-intensive products (e.g., automobiles)	(1) Efforts to reduce exposure through measurement and reduction of carbon emissions associated with raw materials production, product manufacturing, distribution, and retail. (2) Efforts to reduce carbon intensity of their products.
Financing Environmental Impact	This Key Issue evaluates the extent to which companies may face potential credit or reputational risks resulting from indirect exposure to the environmental concerns (including low carbon transition) facing borrowers.	Efforts to mitigate credit risk through integration of ESG risk management policies into the company's overall financing and risk management structures
Opportunities in Clean Tech	This Key Issue evaluates the extent to which companies take advantage of opportunities in the market for environmental technologies.	Efforts to take advantage of opportunities through development of clean tech business segments that are related to the company's core business.

Key Issue	Intent	Management Metrics
Opportunities in Renewable Energy	This Key Issue evaluates the extent to which companies take advantages of opportunities linked to the development of renewable power production.	Efforts to develop renewable power generation capacity and/or proactively complement the development of renewable power through electrical network expansion, equipment commercialization, and "green power" offerings to its customers.

Step 3: Calculate Low Carbon Transition Category and Score

Computation of Low Carbon Transition Score

In the next step, MSCI ESG Research calculated the Low Carbon Transition Score by applying an adjustment factor to the Low Carbon Transition Risk Exposure Score based on the Low Carbon Transition Risk Management Quartile. This has the effect of increasing the final score, reflecting a better position for companies with stronger management. The largest adjustment applies to first quartile companies, a smaller adjustment to second quartile companies, and no adjustment to those in the third or fourth quartiles.

Exhibit A4.4: Adjustment Factor and Low Carbon Transition Risk Management Quartile

Low Carbon Transition Risk Management Quartile	Adjustment Factor
First quartile	10%
Second quartile	5%
Third and fourth quartile	0%

In the final step, the management-adjusted Low Carbon Transition Risk Exposure Score (scale 10 to -4) is translated to a 0-10 scale to compute the Low Carbon Transition Score using the linear interpolation method. Management-adjusted Low Carbon Transition Risk Exposure Scores of 10 and -4 are assigned the values of 0 and 10 respectively on the Low Carbon Transition Score scale (0-10) and other values are derived using linear interpolation using those two values.

Computation of Low Carbon Transition Category

First and second quartile Asset Stranding and Transition companies breaching the category thresholds after adjusting for their LCT Management Score (see Exhibit 2 and Exhibit A4.4) are recategorized into the Transition and Neutral categories, respectively.

Similar to the Low Carbon Risk Exposure Category, a company can only be classified as Asset Stranding in the final Low Carbon Transition Category if it is associated with the fossil fuel value chain.[22]

Exhibit A5.5: Low Carbon Transition Category and Score equivalence (as of February 2024)

Low Carbon Transition Score (0-10 scale)	Low Carbon Transition Category
<= 2.09	Asset Stranding
2.09 > To <= 5.65	Transition (Operational/Product[24])
5.65 > To <= 7.12	Neutral
> 7.12	Solutions

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