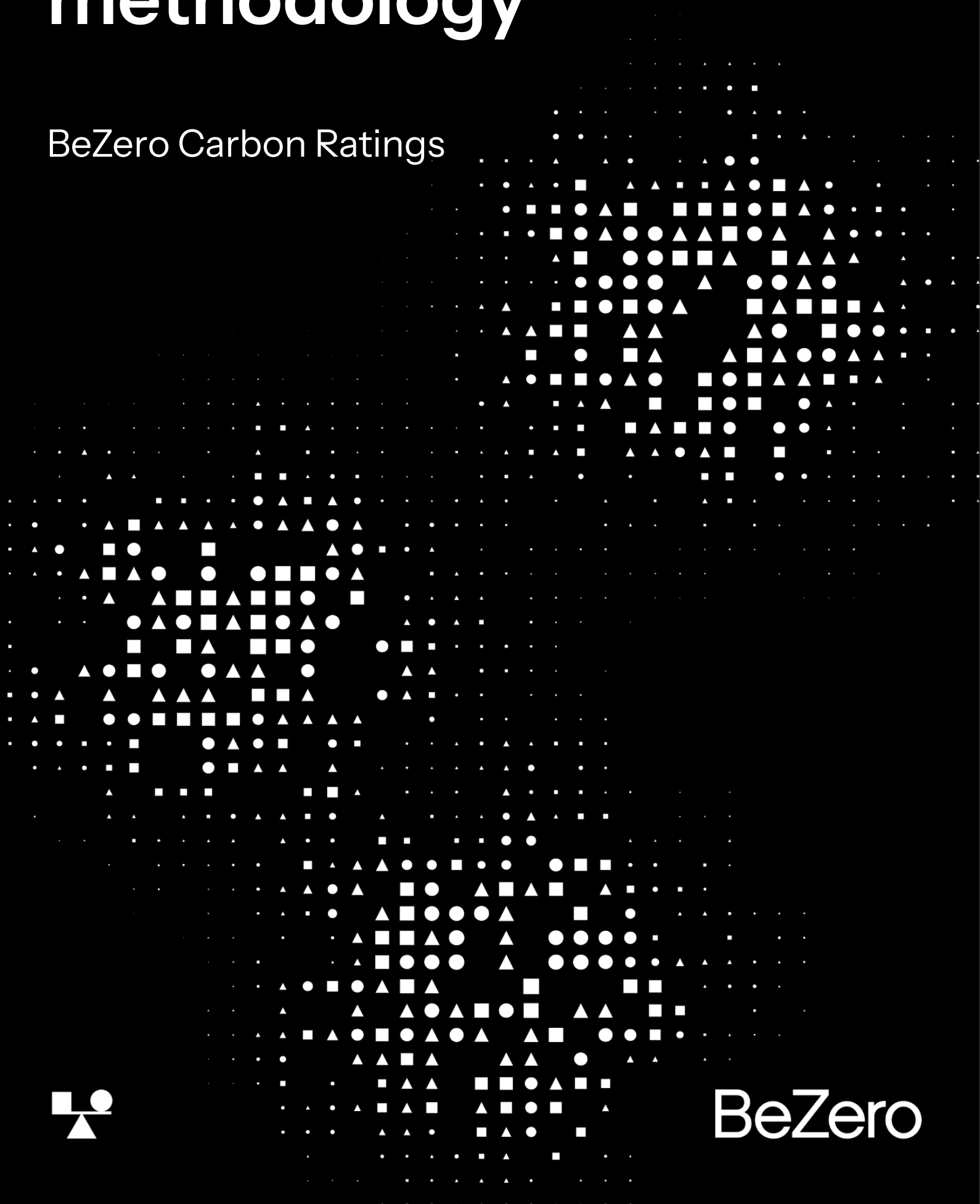
Industrial Processes methodology

BeZero Carbon Ratings



BeZero

Contents

Introduction **4**
What is the Industrial Processes sector group? **4**
Sub-sectors within the Industrial Processes sector group 4
Additional sub-sector qualifiers **6**
BeZero Carbon Rating analytical framework and process for the Industrial Processes sector group **7**
Holistic assessment **7**
Carbon efficacy assessment **9**
Additionality **9**
Activity Analysis **9**
Common practice analysis 9
Alternatives to the proposed project 10
Financial Analysis **10**
Prior consideration of carbon finance 10
Investment analysis 11
Barrier analysis 12
Legal and Policy Analysis **13**
Policy Support 13
Carbon Accounting **16**
Reconstructing the project's crediting structure 16
Direct accounting 16
Baseline scenario 16
Project scenario 17
GHG conversions 18
Leakage accounting 19
Activity displacement 19
Market leakage 19
Permanence **21**
Carbon stock integrity 21
Forward crediting structure 21
Updates and reviews **22**

Introduction

BeZero Carbon is a global ratings agency for the voluntary carbon market (VCM). Our ratings provide a publicly available, risk-based framework for assessing carbon efficacy. We rate qualifying carbon credits in all sectors.

We take a research-first mindset, fusing traditional capital markets research practices with expertise in environmental sciences and technology. We think creatively about climate problems and build solutions the whole market can use.

We have developed extensive analytical frameworks to rate carbon credits on their likelihood of delivering on their promised carbon emissions avoidance or removal. These analytical frameworks are deeply sector nuanced and bring to the fore our extensive experience in rating hundreds of projects across dozens of sub-sectors.

Our ratings team is made up of over 60 analysts who create the models and perform the analysis for every rating. They combine expertise in climatic and Earth sciences, in disciplines from remote sensing, forest ecology, ecosystem disturbance, peatlands, and blue carbon through to statistics, machine learning, artificial intelligence, sell-side financial research, industrial engineering, and public policy. They hold over 20 PhDs, have published over 200 academic papers, and have been cited over 10,000 times in peer-reviewed, scientific academic literature.

As the market's number one risk metric, our ratings are available on our website and dozens of marketplaces, and alongside extensive analysis and research on our BeZero Carbon Markets platform.

What is the Industrial Processes sector group?

The Industrial Processes sector group covers the reduction of emissions across various stages of industrial value chains. BeZero Carbon's Industrial Processes methodology is a tool for users of the BeZero Carbon Rating to better understand our multifaceted ratings approach to this sector group. We present select case studies to showcase the various parameters through which we assess risk to the carbon quality of credits and show how the Industrial Processes sector group relates to our overarching ratings methodology. For more details on the overall ratings methodology and other methodology documents, please see here.

Industrial Processes projects issue avoidance credits by reducing the greenhouse gas emissions associated with a variety of industrial activities, typically related to the manufacture, reclamation, utilisation, or abatement of chemicals and other substances, such as refrigerants, waste heat and nitrous oxide. In the BeZero Sector Classification system, Industrial Processes is one of six sector groups, with three sectors and ten sub-sectors within it.

Sub-sectors within the Industrial Processes sector group

The sub-sectors within each sector further delineate projects by the sector or process they address, or by the nature of the activity they undertake. The specifics of a project's stage of intervention and activity largely determine how we assess each risk factor.

Industrial Emissions sub-sectors are delineated by reducing emissions across specific industrial sources:

- **Carbon Capture and Storage** - capturing CO_2 from industrial sources for geological storage.
- **Carbon Capture and Utilisation** - capturing CO_2 from industrial sources for use in materials.
- **Industrial Methane Emissions** - avoidance of methane emissions from industrial sources and legacy fossil fuel infrastructure.

- **Nitrous Oxide (N_2O)** - avoidance of N_2O emissions from nitric and adipic acid production processes.
- **Ozone-Depleting Substances and Other Refrigerants** - avoidance of emissions of high GWP substances in the refrigerants sector by reclamation, substitution or destruction.
- **Sulphur Emissions** - avoidance of sulphur hexafluoride (SF6) emissions from magnesium production and electrical equipment by substitution, recovery or destruction.

Manufacturing Industries sub-sectors are defined by reducing emissions at specific stages in various manufacturing processes:

- **Industrial Process Efficiency** - improving efficiency at one or multiple stages of a production process.
- **Alternative Materials** - facilitating production or uptake of alternative materials with a reduced footprint compared to the common practice.

Transport sub-sectors are delineated by reducing emissions in fuel sectors or in infrastructure construction and management processes:

- **Transport Fuel & Efficiency** - reducing emissions by increasing the efficiency of transport fuels or processes.
- **Transport Infrastructure & Management** - alternative approaches to transport infrastructure and maintenance.

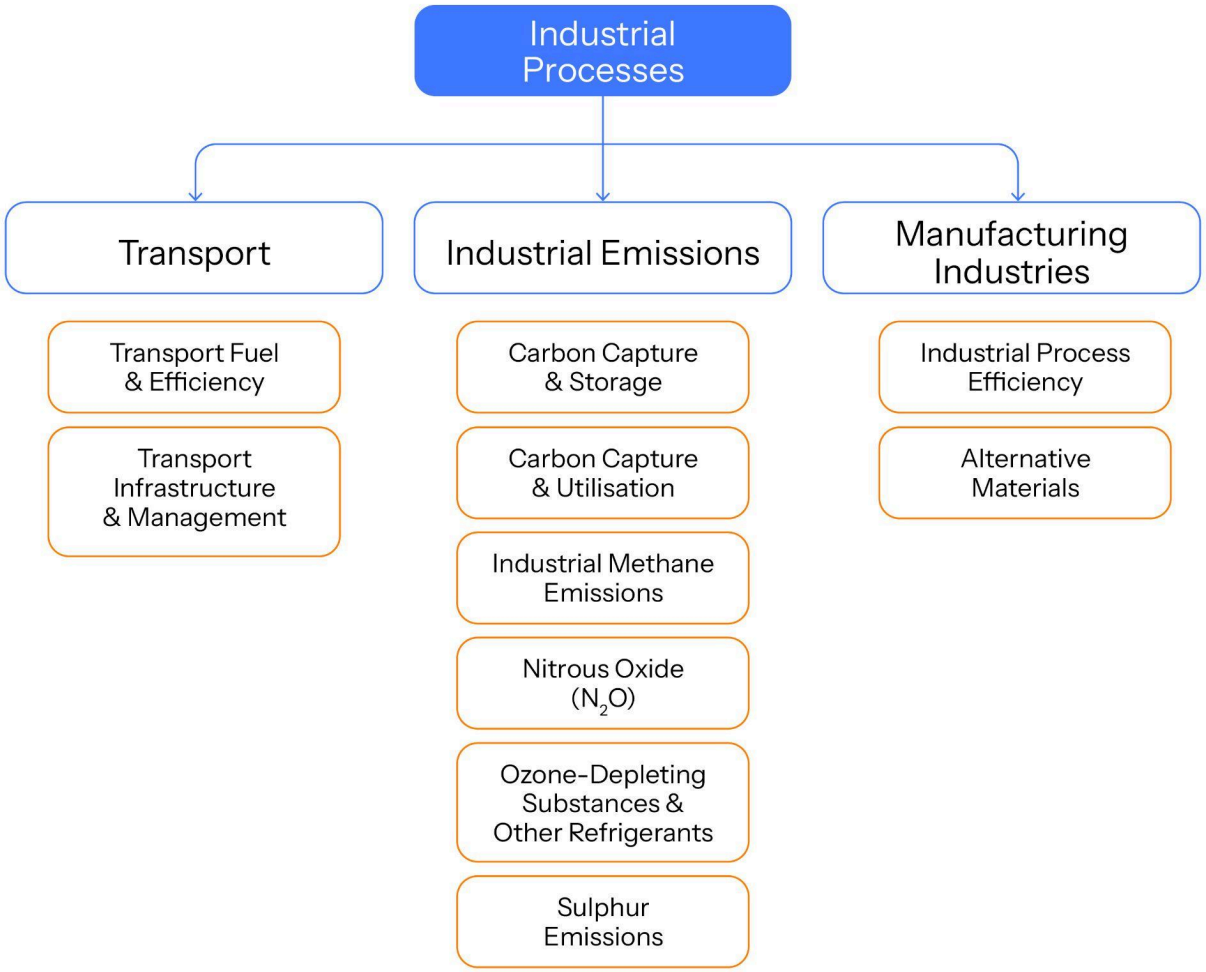


Figure 1. The Industrial Processes sector group within BeZero's Sector Classification System.

Additional sub-sector qualifiers

In addition to our sector classification, each sector can have additional unique qualifiers which enable project labelling and grouping. These labels help to further characterise use cases, baselines and other analytical nuances, and are not necessarily mutually exclusive. Table 1 sets out the qualifiers applied across the Energy sector group.

Table 1. Additional sub-sector qualifiers.

Additional Qualifier	Options	Descriptions
Destruction activity in project scenario	Nitric acid	Emission reductions generated through the destruction of nitrous oxide associated with nitric acid production processes
	Adipic acid	Emission reductions generated through the destruction of nitrous oxide associated with adipic acid production processes
Methane source	Upstream oil & gas	Projects that generate emission reductions from methane released by oil and gas production
	Upstream coal mine	Projects that generate emission reductions from methane released from coal mines
	Downstream distribution network	Projects that generate emission reductions from methane released from downstream gas distribution networks
Activity type	Methane capture: Capture & Destruction	Emissions reductions generated by the capture and destruction of methane
	Methane capture: Capture & Utilisation	Emissions reductions generated by the capture and utilisation of methane
	Plugging wells: Orphaned	Emissions reductions generated by the plugging of orphaned oil wells
	Plugging wells: Abandoned	Emissions reductions generated by the plugging of abandoned oil wells
	Plugging wells: Active	Emissions reductions generated by the plugging of active oil wells
	Ozone-depleting substances & other refrigerants: Reclamation & Destruction	Emissions reductions generated by the reclamation and destruction of ozone-depleting substances or other refrigerants
	Ozone-depleting substances & other refrigerants:	Emissions reductions generated by the reclamation and recycling of ozone-depleting substances or other refrigerants

Reclamation & Recycling	
Ozone-depleting substances & other refrigerants: Replacement	Emissions reductions generated by the replacement of ozone-depleting substances or other refrigerants with lower-GWP alternatives

BeZero Carbon Rating analytical framework and process for the Industrial Processes sector group

We have designed an approach to assessing the carbon efficacy risk for issued carbon credits. This framework is applicable to any project type in any sector accredited by any standards body, and leverages a blend of qualitative and quantitative factors; financial, environmental, and policy assessment techniques; and primary and secondary data sources.

Our BeZero Carbon Rating Methodology details our risk based assessment for understanding and interrogating the efficacy of issued carbon credits of any type, in any sector and country.

The BeZero Carbon ex ante Rating Methodology similarly describes our framework for assessing carbon efficacy of credits yet to be issued from projects of any type, in any sector and country. Ex ante ratings will also consider project execution risk.

Sector methodologies can be seen as nested within the overarching ex post or ex ante methodologies. The overall rating definitions, risk factors and risk driver categories are common across all projects while the sector methodologies complement the overarching methodologies.

This document provides an extension to our overarching rating methodology. It presents BeZero's detailed analytical framework and process for assessing Industrial Processes projects. Using select case studies, it showcases the various parameters through which we assess risk to the carbon quality of these credits, and how this sector relates back to our overarching ratings methodologies.

Holistic assessment

The assessment of a carbon credit's efficacy includes a detailed, project-specific, bottom-up, and top-down analysis, to provide a comprehensive assessment of risk. Further details on the risk factor definitions, the rating process, and the overall risk assessment can be found in our BeZero Carbon Rating Methodology. For pre-issuance ratings please consult the BeZero Carbon ex ante Rating MethodologyBeZero Carbon Ex ante Rating Methodology.

Important elements of the BeZero Carbon rating process that are applicable to all project types are described in detail in these documents (but not repeated in this document). These include:

- The steps in the rating process
- The project governance assessment
- Project boundary auditing
- Assessing the risks of double counting
- The integrity of reported issuance
- Assessing rating eligibility (whether projects meet our three primary qualifying criteria)
- The rating assignment process
- The role of the BeZero Carbon Rating Committee
- Ongoing monitoring and 'rating watch' process

Carbon efficacy assessment

Whilst the foundational questions that underpin a BeZero Carbon Rating converge at the risk factor level, the inputs used to answer these questions show increasing specificity at the sub-sector and project levels.

Additionality

The likelihood that a project's activities are materially different from the counterfactual or business-as-usual activities.

Table 2 sets out the risk drivers within our assessment of additionality. In the sections that follow we detail the key parameters that factor into each level of risk assessment.

Table 2. Sub-components of additionality assessed.

Risk factor	Risk driver category	Risk driver
Additionality	Activity analysis	Common practice analysis
		Alternatives to the proposed project
	Financial analysis	Prior consideration of carbon finance
		Investment analysis
		Barrier analysis
	Legal and Policy analysis	Policy Support

Activity Analysis

Common practice analysis

Our assessment of common practice examines the pervasiveness of the project activities or technology applied by the project within the region and sub-sector with and without access to carbon finance. Projects tend to assess common practice based solely on the number of similar carbon projects operating in the region or country. Our view is that it is important to also assess similar activities in the region or country that have been implemented without carbon finance. This helps to inform additionality as we can evaluate the potential for project activities or outcomes to have occurred either in a business-as-usual scenario or as a result of similar initiatives.

We leverage our internal markets database to assess the prevalence of all other voluntary carbon market projects in the area that are registered on five major standards bodies: American Carbon Registry, Clean Development Mechanism, Climate Action Reserve, Gold Standard, and Verra. To the extent possible and relevant, we also check other standards bodies such as Cercarbono, CSA Group and Puro Earth. As with all our analysis, exhaustive literature reviews are conducted to unearth any programs or interventions conducting similar activities that may have otherwise been overlooked.

Given that many Industrial Processes projects utilise highly specific technology and operate in markets with a limited number of participants, it is common for projects to identify their activities as not being common practice or having limited market penetration. For some projects, activities are first-of-their-kind within the region or country or given the scale of the intended greenhouse gas impact. This may be due to the nascency of the project activity, or because barriers are highly significant. We use our internal markets database to estimate whether other Industrial Processes project activities occur at similar scales and timeframes, and how contingent these other activities are on carbon finance. Beyond the voluntary carbon market, we will assess whether or not a project activity appears to be the first of its kind in its industry or location too, as part of our holistic assessment of additionality risk.

Alternatives to the proposed project

Another key aspect of additionality assessments is understanding the likelihood and extent of alternative scenarios that may occur in the absence of a project. For Industrial Processes projects, these may include the implementation of the project activity in the absence of carbon finance, the use of a more common production method or technology to achieve the same emissions outcome, or the implementation of the project at a scale different to that proposed, among other examples. It is important to examine the credibility of each scenario to assess whether one is more likely to occur, as this necessarily influences the baseline.

This component of our analysis is interlinked with our assessments of common practice and barriers faced by the project, and also the quantification of baseline emissions and removals in the Carbon Accounting. However, our analysis of alternative scenarios requires an even more nuanced approach, as there may be specific characteristics relevant to the project that make regional or even local common practices less favourable. For example, certain raw materials may be more abundant in certain sub-national regions, resulting in different barriers for the same activity in different states or provinces of the same country. To examine this, we will not just consider national-level data but understand the local production and consumption dynamics where possible, to create the fullest picture of the project activity in its specific context.

Forward crediting projects. Some projects issue all of their credits at the start of their crediting period in a single vintage. The activity that leads to emissions reductions is implemented in the past, but the emission savings would have occurred over a longer time period into the future in the baseline scenario. The forward-crediting considers them achieved once the 'activity' is complete, for example once an ozone-depelting substance is certified to have been destroyed. For these types of projects, our view of alternative scenarios extends across the entirety of the crediting period. Similar to our ex ante assessment, this takes into account the potential for emissions reductions to have been achieved in the counterfactual scenario (in the absence of project) over the crediting period. Forward crediting structures also impact our carbon accounting and permanence assessments.

Financial Analysis

Prior consideration of carbon finance

Within this component of assessment, we also analyse aspects fundamental to the additionality of all carbon projects, such as evidence of prior implementation of the project in the absence of carbon

finance. In these cases, the ability to pass a financial additionality test, and demonstrate the presence of barriers and a lack of common practice may be redundant were the activities already occurring in a business-as-usual scenario.

Investment analysis

We consider the investment barriers that may be faced by project activities. To enable this, we seek to corroborate the validity of the data underlying a project's additionality assessment using independent data sources, industry data, peer-reviewed research and in-house expertise. Factors assessed include reported internal rates of return, reported payback periods and trends of investment and capital flow prior to project implementation among others. We also screen methodologies to assess risks associated with applying outdated or overestimated investment benchmarks and subjectivity around future costs. This allows us to better assess what role carbon finance plays in the implementation of a specific project, the extent of the proponent's prior financial means in comparison to a project's initial capital requirements, and if any financial incentives exist for the proponent to undertake the project activity in the absence of carbon finance.

Some additionality tests do not require that cost savings as a result of the project activities be incorporated, which may allow additionality to be granted because the project does not result in additional income for the proponent. However, they may still result in significant cost savings that represent a material financial incentive to undertake the project activities, which we assess as part of our analysis.

We do note the existence of cases where there is no financial incentive to undertake a project, despite a proponent likely having the financial means to do so. In these cases, we may deem carbon finance likely to be additional despite a proponent's other financial resources, as carbon finance is likely to compensate for the opportunity cost associated with the use of those funds for an endeavour that is not revenue-generating.

Revenue analysis. In cases where assessing the project's total financial picture, including likely costs, is not possible, we may undertake an analysis of the various revenue streams available to the proponent to support project implementation. For most Industrial Processes projects, other income streams beyond carbon finance support the project's operations. It is important that we assess the extent and significance of these alternative sources of revenue, to ensure that project interventions are at least partially dependent on carbon finance and that the project activities are not likely to have otherwise occurred.

For example, many projects involve the commercial production of various industrial commodities, such as refrigerants, construction materials and fuels like natural gas and oil, among other products. Given that the project is able to derive income from selling the product of its operations, this may provide an incentive to undertake the project activity in the absence of carbon finance, especially if there is robust evidence that this product can be sold at a profit. By using national, regional and project-specific data sources to identify the presence and magnitude of alternative revenue streams, we evaluate the significance of carbon finance for project implementation.

Benchmark analysis. When undertaking financial analysis, projects often use a benchmark to show that its internal rate of return (IRR) in the absence of carbon finance is not adequate to incentivise the project activity despite still being positive and therefore suggesting some level of profitability. For this approach to support additionality, the benchmark must be appropriately selected. In cases where our review suggests the benchmark IRR value is not likely to be appropriate (i.e. it is not useful to assess the attractiveness of the project's specific investment), the project's financial analysis is undermined.

Barrier analysis

For Industrial Processes projects, barriers arising from opportunity costs, inadequate upfront capital and technical capacity may inhibit activities from occurring and support a project's additionality. These barriers are often unique to the project's location and circumstance. To assess the presence and scale of these barriers, our analysis for Industrial Processes projects is driven by academic literature, industry reports, technical specifications and market data. Not only does our assessment consider the existence of barriers but also the role of carbon finance in alleviating them. The latter aspect is pivotal as some barriers may be overcome by means other than carbon finance.

Barriers can span several different categories. These are tabled below.

Table 3. An indication of the barriers that may affect the implementation of carbon projects.

Investment barriers	While potential cost savings may give a strong incentive for the implementation of project activities, this may be countered by the lack of access to upfront capital to implement project activities. This may be more difficult for activities in developing or low-income countries where the financing mechanisms that exist in more developed markets are generally seen to carry increased risk. As part of the larger assessment on additionality, we consider how having access to carbon finance, an external revenue stream that is typically in the US dollar, can aid a project in accessing the capital required to be implemented.
Technical and operational barriers	Technological and operational challenges may similarly prevent a project's implementation where insufficient investment and financing exist. An example may be access to technical expertise, which a formalised structure such as the carbon market could facilitate, or investment in new technologies that are not in widespread commercial operation.
National barriers	We find that barriers to industrial investments can often exist at a national level, which can help substantiate claims of additionality. To assess these, BeZero conducts in-depth literature reviews considering the context of a country's industrial environment whilst also relying on other independent forms of national classification; an example being the United Nations (UNs) least developed countries (LDCs). As defined by the UN, these are low-income countries confronting severe structural impediments to sustainable development.

Investment barriers are evaluated in more detail in other sections of this methodology. Here we shall expound on our assessment of technical and national barriers.

Technical barriers. Technical barriers are a critical area of analysis for Industrial Processes projects, as these projects tend to be technically complex and require expensive, specialist infrastructure. Our assessment focuses on whether the project activity faces technical challenges that pose barriers to successful implementation, and the way that increased financial resources may be able to overcome these technical challenges, such as through the hiring of specialist staff members, investment into research and development or the purchase of additional equipment.

National classification. We use a country's national classification to understand the barriers which may be faced by project activities due to barriers which are inherent to the country in which it operates. These national classifications are important to inform the context in which the project operates. For example, a classification as a 'Least Developed Country (LDC)' (as defined by the United Nations) may be relevant to risk of investment. Typically, we would expect fewer additionality risks to be associated with projects in LDCs, as there are likely to be bigger barriers to project implementation. In contrast, a high-income country will likely have more significant additionality risks as it is likely that there would be alternatives to carbon finance to overcome financial barriers.

Ultimately, our assessment of a project's financial additionality boils down to a few key elements: what barriers is carbon finance required to overcome in the case of this specific project; what alternative sources of finance are available to the proponent to meet these needs in the absence of carbon finance; and what other incentives exist for the project proponent to choose to overcome these needs in the absence of carbon finance. By seeking to answer these questions, we can evaluate the financial picture of a project and assess the implications of this for both a project's additionality risk and overall carbon efficacy.

Legal and Policy Analysis

Policy Support

Our assessment of policy support interrogates whether there are existing laws, regulations, statutes, legal rulings, or other regulatory frameworks which require the implementation of project activities (either directly or indirectly). However, these assessments are only conducted at a single point in time and are therefore not likely to reflect the broader regulatory environment preceding the project's start date nor throughout its crediting period, should sufficient evidence be available to support this analysis. We will explore the regulatory environment that pertains to the development and entire operational period of the project where possible. For Industrial Processes projects, this typically involves investigating regulations related to increased adoption or development of greener manufacturing processes, inputs or disposal practices.

The impact of this on our rating is closely related to our assessment of government effectiveness, where we analyse the implementation, enforcement, and overall effectiveness of policy regulations and initiatives. Where we find evidence of regulations that mandate project activities in combination with high levels of government effectiveness, we would consider this to increase additionality risk. Given the often close, established links between the state and heavy industry, this is typically a major factor for Industrial Processes projects. This may differ from the methodologies for other sub-sectors and sector groups.

Regulation effectiveness. In our assessment of Industrial Processes projects, we thoroughly evaluate the effectiveness of government policies at a national, regional, and local level. Governments hold a crucial responsibility in formulating policies, allocating resources, and coordinating actions to regulate the greenhouse gas emissions of heavy industry. This assessment encompasses various aspects, such as the presence of well-defined and comprehensive legislative frameworks and regulations that support the mitigation of industrial gas emissions.

Our analysis encompasses the implementation, enforcement, and overall effectiveness of policy regulations and initiatives. Additionally, we consider the allocation of financial resources, both domestically and through international cooperation, to facilitate Industrial Processes projects. By conducting a comprehensive evaluation of these factors, we aim to gauge the efficacy of government policies in promoting sustainable industrial practices.

Major policies. As part of our assessment of additionality, we analyse any major policies or initiatives that may affect the country or region where the project is located. We identify government or

external strategies which aid the development and deployment of the same or similar technologies in the relevant industry. In our view, the existence of major policies and initiatives is likely to show a supportive environment for the project activities - as long as they are effectively implemented. If this is the case, we find that project activities may have been introduced without the need for carbon finance. However, in our assessment, we analyse how successful the policy or initiative has been. If the policy has not been implemented effectively, this may not increase additionality risk, or even decrease it. Our view of the policy relevant to a project includes all relevant policies: local, regional, national and international. We will also consider how these regulations interact, where relevant.

National climate and green investment landscape. For Industrial Processes projects we assess investment opportunities and activities related to climate change mitigation and adaptation within a specific country. This may include the presence of policies, regulations, and incentives that support the project activities, such as tax relief, grants, subsidies and the market potential for industrial projects in the relevant country.

Second, we identify ongoing and planned projects, their scale, scope, and location, and assess the number of industrial facilities that could implement the project activities and the technologies they currently employ.

Third, we identify the potential risks associated with investments into Industrial Processes projects, such as policy and regulatory risks, market volatility, supply and demand issues and lack of infrastructure.

Fourth, where relevant, we consider factors such as project readiness, scalability, and potential co-benefits to determine attractive investment opportunities, and evaluate the financial viability, profitability, and risk-return profile of different investment options.

Nationally determined contribution. Assessing the Nationally Determined Contribution (NDC) of the project's host country is a factor in our top-down policy analysis for Industrial Processes projects. This refers to the commitment made by each participating country to outline its efforts in mitigating greenhouse gas emissions and adapting to the impacts of climate change.

NDCs may consider industrial decarbonisation to be a high national priority from an emissions perspective, suggesting that the government may wish to implement project activities (or other, similar sustainable practices) in the absence of carbon finance. Industrial Processes projects typically involve gases beyond carbon dioxide, such as methane, nitrous oxide and various hydrofluorocarbons (HFCs). Emission reductions of these gases may also be included in a country's NDCs. However, NDCs are not binding, so we will also assess the efforts undertaken to achieve these targets and the likelihood of efficacy.

Other targets. Outside of NDCs, we also assess the scope and effectiveness of any other state, national or international targets that may be relevant to a project's activities. Given the challenges in decarbonising many industrial processes and the high emissions that often result from them, there are often government targets relevant to the emissions produced by various industrial activities. However, the amount of state support provided to achieve these targets varies, which modulates a project's additionality risk.

Competing industries. As part of our assessment of the additionality risk for Industrial Processes projects, we will also assess the policy environment relevant to any major competing industries. This is because we understand that the policies relevant to a project activity - particularly sustainable technologies - may be undermined by, for example, ongoing policy support for polluting practices that are deeply economically entrenched. This provides us with the fullest picture of the regulatory dynamics relevant to a carbon project.

Carbon Accounting

The likelihood that, or degree to which, climate benefits are accurately or conservatively quantified.

Table 4. Sub-components of our over-crediting assessment.

Risk factor	Risk driver category	Risk driver
Carbon accounting	Direct accounting	Baseline scenario
		Project scenario
		GHG conversions
	Leakage accounting	Activity displacement
		Market leakage

Reconstructing the project's crediting structure

Our assessment of carbon accounting begins by reconstructing how a project arrived at its net issuance across the rated vintage period, so that the effect of each subsequent finding can be located within that structure.

Using project-reported values, we establish the project's total gross emissions reductions as the difference between emissions under the baseline and project scenarios.

Separately, we construct the equivalent quantities on our own terms to obtain our best estimate range for comparison. Where our analysis of the risk drivers below leads us to a different view of the counterfactual, of reported project emissions, or of the appropriate leakage deduction, we quantify the emissions reductions that our own assumptions would imply, and arrive at a BeZero view of net emissions reductions for the rated vintages. The proportion of the project's claimed net issuance that our analysis does not support is the central output of our carbon accounting assessment, and the primary determinant of the risk factor score.

Three points of method follow from this. First, quantification is attempted wherever the evidence permits it, including where we conclude that a project's accounting is conservative rather than aggressive. Second, non-trivial assumptions are sometimes unavoidable. Third, in many cases we also need to consider the range and shape of uncertainty, strength of the scientific consensus that underpins the estimations, the likelihood of other unknowns, and other more qualitative considerations. Where the evidence supports a range rather than a point estimate, we present a range, and in conditions of material uncertainty we prefer to do so.

Direct accounting

Baseline scenario

A critical part of assessing a project's carbon accounting risk is evaluating how well the baseline emissions are quantified by the project. The emissions baseline of a carbon project is the amount of emissions that have previously occurred or would likely continue to occur in the absence of any

mitigation strategies. This is then typically compared with the emissions that result in the project scenario, and the difference between these two values comprises the project's emissions reductions. An appropriate baseline relies on the use of representative historical data and/or models to forecast future emission scenarios. Ideally, the baseline would also incorporate the likelihood that emissions reductions occur during the project's crediting period as a result of exogenous factors, such as improving industry standards and changes in regulation, if a historical precedent exists for this.

Project scenario

Project emissions. Our assessment of accurate carbon accounting also considers project emissions, which are emissions that occur during the implementation of the project. These must be deducted from the project's gross issuance to increase the likelihood of accurate crediting.

For Industrial Processes projects, project emissions often result from:

- The emissions associated with fossil fuel consumption on-site;
- The emissions from any electricity consumed by the project activity;
- Emissions associated with the release of lower-GWP substances as the project activity (while these must be lower than the emissions that result from the release of the baseline substance for the project to be effective, they still may not be zero);
- Emissions due to inefficient abatement of project gases.

These sources are often small in both an absolute sense and relative to avoided emissions. However, this is not universal, and external emission sources associated with a project can present a material source of emissions.

Dual-activity projects. In cases where projects claim emission reductions for two different activities, we will assess the relative contribution of these activities to the project's overall issuance and incorporate this information into our rating accordingly. This typically refers to projects that both capture a greenhouse gas and subsequently utilise it, as emissions reductions result from both avoiding the release of the gas and its utilisation.

The activity that results in the majority of a project's emission reductions will have a greater influence on the project's headline rating.

Physical leakage rates. Another common factor relevant to the carbon accounting risk of Industrial Processes projects is the rate of physical leakage of gases from industrial equipment or systems. For projects that involve replacing a higher-GWP substance with a lower-GWP substance (which is the majority of projects in the Ozone-Depleting Substances and Other Refrigerants sub-sector), reliable values for the likely leakage rates at each stage of the project's lifetime are critical to accurate crediting. These stages typically include the manufacturing, operation and disposal of the relevant project equipment.

Monitoring practices. The monitoring practices employed by a project are also highly relevant to its carbon accounting risk, as this determines the robustness of the project's data collection. In our view, Industrial Processes projects tend to use reliable monitoring practices, as they typically utilise regularly calibrated continuous flow metres to record the amount, composition, concentration and/or pressure, among other possible characteristics, of the various gases and other chemicals involved. Where relevant, the weight of the substances involved in the project also appears to be monitored reliably, as does the use and generation of electricity. At the publication of this methodology, we consider 90% of our rated Industrial Processes projects to utilise reliable and accurate monitoring practices, reducing carbon accounting risk.

GHG conversions

Global warming potentials. A key metric used when calculating the total emissions reductions of an Industrials Processes project is the global warming potential (GWP). This is used as a multiplier for any project that avoids emissions associated with non-CO_2 gases, typically methane, hydrofluorocarbons and nitrous oxide for Industrial Processes projects. The GWP was designed by the IPCC to allow for comparisons between the global warming impacts of different gases. It is essentially the measure of how much energy the emissions of one tonne of a certain gas will absorb over a given period, compared to the emissions of one tonne of carbon dioxide (CO_2). Both project documentation and our analysis use the GWP value for 100 years unless otherwise stated. The use of GWP values that have been since superseded by the latest IPCC established consensus values, can lead to over- or under-crediting. Under-crediting effects can compensate for over-crediting in other areas of carbon accounting, if appropriate.

Table 5. The latest GWPs attributed to various greenhouse gases.

	Lifetime (years)		
Greenhouse gas	**20**	**100**	**500**
Carbon dioxide (CO_2)	1	1	1
Methane (CH_4)	82.5	27.9	7.95
Nitrous Oxide (N_2O)	273	273	130
HFC-134a	4140	1530	436

Emission factors. Emission factors represent the rate at which a given activity releases greenhouse gases into the atmosphere. This can apply to several industrial processes, such as the abatement of nitrous oxide emissions and the capture and utilisation of methane or waste heat for power generation. We will assess the source of the emission factor applied or the method used to calculate it, and compare this to independent estimates from the relevant literature or databases. The use of emissions factors that do not align with industry standards or independent assessments can be a source of both over- and under-crediting risk, depending on the specific project, its activity and its issuance calculations. Most commonly, we see emissions factors used in Industrial Processes projects to calculate the emissions reductions that result from displacing electricity generation from the relevant grid, which is likely more emissions-intensive than the project's method of electricity generation.

Emission factors may be applied statically or dynamically. Static emission factors are generally calculated ex-ante based on historical data (often using the average grid data in the three years preceding the project's implementation) and remain fixed across the crediting period. This means they often overlook grid trends that emerge within crediting periods which can have varying implications on emission reduction claims. For example, a grid which experiences fluctuations in its emission factor may result in a project over-crediting in one year and under-crediting in the next. Here, we calculate the crediting risk on an annual basis and balance the risk of over- and under-crediting to provide an overall understanding of risk across the project's crediting period.

Comparatively, dynamic emission factors are calculated periodically throughout a project's crediting period and may better capture grid trends. This method often results in reduced over-crediting risk, in our opinion, as the counterfactual is more likely to reflect observed trends.

Other metrics. Given the technological diversity of Industrial Processes projects, they use a variety of metrics when calculating emission reductions. Aside from the factors already discussed (and that are more typically employed), we have assessed projects that require the use of a value for the fraction of non-renewable biomass (fNRB, eg. in brick projects), temperature factors related to vehicle idling systems, and transport users surveys, among other possible issuance inputs. For any factor critical to a project's crediting, we shall assess the specificity and reliability of the values used and the data that underpin them. This can be done by comparing the project's values to estimates from scientific and industry literature and our internal models and databases. In cases where we find that the value used does not align with independent estimates or appear specific enough to the project's technology, scale or location (as is often the case with the use of default values) this is likely to increase the risk associated with a project's crediting.

Leakage accounting

Activity displacement

For Industrial Processes projects, the risk of activity displacement is likely to depend on the specific project activity taking place. For projects that involve adding an additional step into an established product life cycle, such as adding an abatement technology to an existing process or reclaiming a product at the disposal stage, we tend to deem the risk of activity displacement minimal. This is because the vast majority of emissions in these cases are likely the same in both the baseline and project scenarios, aside from those deliberately influenced by the project activities.

Emissions may occur beyond a project's boundaries when there is a risk that the project activities incentivise the additional production of industrial commodities. Projects are not typically required to assess the likelihood of this occurrence. To assess this risk, we consider any relevant, peer-reviewed literature or industry data that suggests that efficiency gains in specific industrial processes lead to increased production levels and evidence from the project that may strongly suggest this possibility.

Our assessment of leakage risk due to activity displacement will also include an evaluation of transport emissions where relevant. Often, we deem leakage due to transport emissions to be immaterial, as the transport infrastructure is likely to be highly similar in both the baseline and project scenarios. In cases where the project activity involves significantly increased transport requirements, we may reflect this as a carbon accounting risk.

Life cycle emissions. Our life cycle emissions analysis investigates the upstream emissions associated with the project. This may include the manufacturing of technological components, transport, distribution, and installation at the project site. Where possible, these emissions are quantified and compared to the stated emission savings that are used to justify the project's credit issuance. The scale of the project is often relevant for this assessment: upstream emissions are more likely to be consequential for small-scale projects, as they will likely comprise a more significant proportion of the project's gross issuance.

Positive leakage. If we feel there is evidence that a project will likely prevent additional emissions beyond those caused by the core project activity, we may assess the project to display positive leakage. This may reduce a project's overall leakage risk level or strengthen our conviction in assigning the lowest leakage risk level in our framework to a project's credits.

Market leakage

Market leakage can occur when a project's activities alter the supply and demand equilibrium. As a result, shifting market dynamics may lead to increased emissions due to market activities moving elsewhere and projects may need to deduct from their issuance to account for this risk. However, for

this to be likely, in our view, a carbon project must influence a significant portion of the supply and/or demand for an industrial commodity. In our experience, this tends not to be the case as most industrial products have myriad producers and are part of globalised supply chains. This means that, in most cases, we do not find the risk of market leakage to be material for Industrial Processes projects. Where possible, we will illustrate this in our ratings by comparing the project's production volumes with those of the overall market, and show that the project comprises a negligible fraction.

Permanence

The likelihood that the climate benefits of the project will persist for the time committed.

Our analysis of this risk factor considers the permanence of the contractual commitment of a given project and its proposed credits. To assess a credit's permanence risks, it is first necessary to determine the time period a credit commits to, and then whether the credit faces reversal risks within that period. Commitment periods are the duration over which sequestration or abatement activities have permanence horizons and differ from crediting periods (the timeframes during which reductions or removals are eligible for issuance as verified carbon credits).

Table 6 sets out the risk drivers within our assessment of permanence.

Table 6. Sub-components of permanence assessed

Risk factor	Risk driver category	Risk driver
Permanence	Technical risks	Carbon stock integrity
		Forward crediting structure

Carbon stock integrity

Carbon rights. Carbon rights are a form of property right which allow accredited carbon units to be owned and traded. Our assessment evaluates who owns the carbon rights for the project area and whether it is likely to confer permanence risks. Carbon rights may be detailed in project documentation, or through project-specific literature. This risk may be reduced where carbon rights are owned by the project developer. In contrast, risk may be introduced where carbon rights are owned by the government, as the project may not have the legal right to sell carbon credits.

Reversal risk. In the case of Industrial Processes projects, there is typically no risk of reversal from a technical perspective. This is because the CO_2e is avoided, not removed, so cannot later be released. There is one primary exception to this: the case of projects in the Carbon Capture, Storage and Utilisation (CCUS) sub-sectors. For projects that involve the storage of carbon, there may be a risk of physical reversal. To evaluate the extent of this risk, we use in-house geological and materials expertise and the relevant scientific data.

Forward crediting structure

Some Industrial Processes projects issue all their credits upon validation, as the project activity itself is completed in the initial year of operation (considered the reporting period for these projects). For example, a project may reclaim and sell its entire shipment of refrigerants during its reporting period, meaning that the project activity is complete and no further action is required on the part of the proponent. However, the actual emission reductions may not all have been achieved at this point, in our view, depending on the specific project activity and its emission profile throughout the project's crediting period. To continue the example from above, we believe the actual emission reduction would occur when the reclaimed refrigerant actually leaked to the atmosphere, as it is at this point that it replaces the virgin refrigerant identified as the baseline scenario.

Assessing risk posed by this approach to crediting often depends on the emission rates used by the project to model its expected emission reductions throughout the crediting period. In cases where projects have issued all their credit upon validation, we may assess increased permanence risk of the project's credits, as we believe there is a risk that the emission reductions do not proceed as modelled and therefore that some credits may not represent achieved emission reductions.

Updates and reviews

Version number	Date	Description
1.00	14/12/23	Initial release
1.01	03/10/24	Clarification on additionality as a limiting factor
2.0	18/02/25	Updated risk factor framework
3.0	27/10/26	Formatting updates, edits and revisions to align with ESMA regulatory requirements.

Disclaimer

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