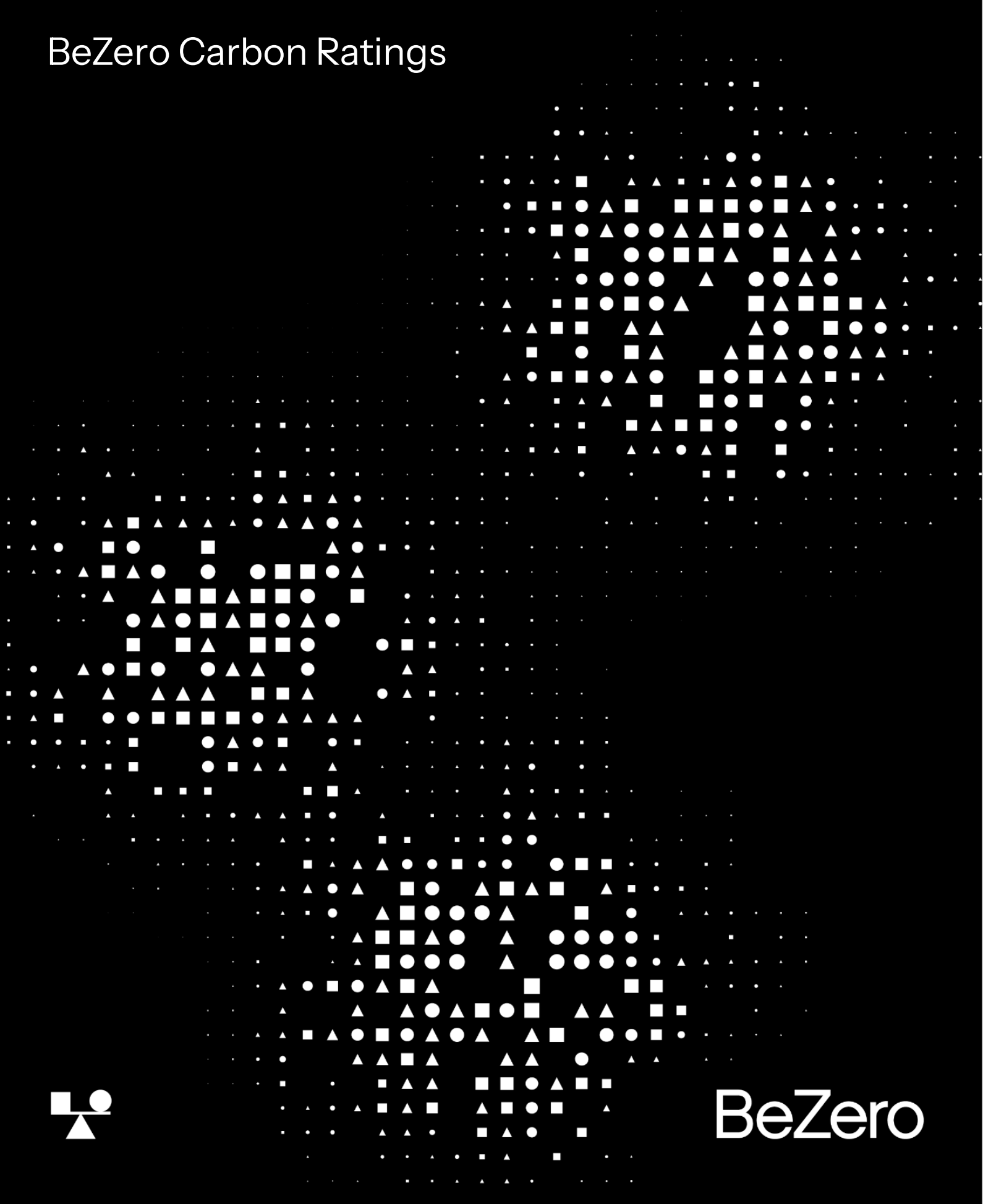
Energy methodology

BeZero Carbon Ratings



BeZero

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Introduction

BeZero Carbon is a global ratings agency for the carbon market. 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, Geospatial, Data, and Research teams are made up of dozens of climate and data scientists, geospatial experts and financial market analysts. They bring with them the highest academic and industry credentials, a tenacious approach to scientific inquiry and a dedication to climate action through science. They hold PhDs and qualifications in disciplines from remote sensing, forest ecology, ecosystem disturbance, peatlands, and blue carbon to statistics, machine learning, artificial intelligence, financial research, industrial engineering, and public policy. They have published hundreds of academic papers and have been cited tens of thousands of 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 Energy sector group?

Projects across the Energy sector group issue emission avoidance credits related to energy generation, use or storage. They do so through three broad mechanisms: by generating energy from a resource that displaces energy which would otherwise have been supplied by more emission-intensive means; by generating energy at a lower emission intensity than the baseline alternative using a fossil fuel source; and by reducing the quantity of energy that end-users demand, or switching the fuel with which that demand is met.

The energy form in question is most frequently electricity, but heat and liquid fuels are also within scope. Projects may be connected to a centralised grid, operate off-grid or supply power for captive use.

This document covers four of the sectors within BeZero's Energy sector group:

- **Renewable Energy** — projects that issue avoidance credits by displacing energy that would otherwise have been generated from more emission-intensive resources.
- **Non-Renewable Energy** — projects that issue avoidance credits by producing energy with a lower emission intensity relative to a baseline alternative, using fuel sources that are considered to be finite. Non-Renewable Energy projects differ from Renewable Energy projects in that the latter typically have near-zero marginal emissions, which is not the case for the former.

- **Energy Efficiency** — projects that increase the carbon efficiency of energy systems by reducing energy demand from commercial, industrial and residential end-users, improving generation output, or switching to less emission-intensive fuels.
- **Energy Infrastructure** — Projects that support the development and/or maintenance of energy related infrastructure, including but not limited to expansion of the power grid, energy storage, and district heating systems.

Sub-sectors within the Energy sector group

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

Renewable Energy sub-sectors are delineated by the generating resource:

- **Hydropower** — generation from flowing or impounded water.
- **Wind** — onshore and offshore wind generation.
- **Solar** — photovoltaic generation and solar thermal generation of heat.
- **Geothermal** — generation from geothermal heat resources.
- **Biomass (heat and electricity)** — generation of heat or electricity from biogenic feedstocks.
- **Sustainable fuels** — production of liquid or gaseous fuels derived from renewable sources, including biofuels and green hydrogen.

Non-Renewable Energy projects are delineated along two axes rather than by a technology sub-sector list: the **activity type** undertaken (generation, decommissioning, or avoided extraction) and the **fuel source** to which the activity relates (gas, oil, or coal).

- **Generation** — projects that involve the production of energy.
- **Decommissioning** — projects that involve the decommissioning of energy assets.
- **Avoided extraction** — projects that avoid the emissions that would have arisen from the planned extraction of new fossil fuel reserves.

Energy Efficiency sub-sectors are delineated by whether a project reduces energy demand or improves the emission efficiency with which demand is met:

- **Energy saving measures** — projects that reduce energy demand at the point of use. Activities include lighting and appliance replacement programmes, building and facility retrofits, and industrial and institutional demand reduction. The rationale for these activities is typically a cost saving rather than a revenue.
- **Fuel switch** — projects that substitute a less emission-intensive fuel for the fuel used in the baseline, most commonly at an existing generating asset or industrial facility.

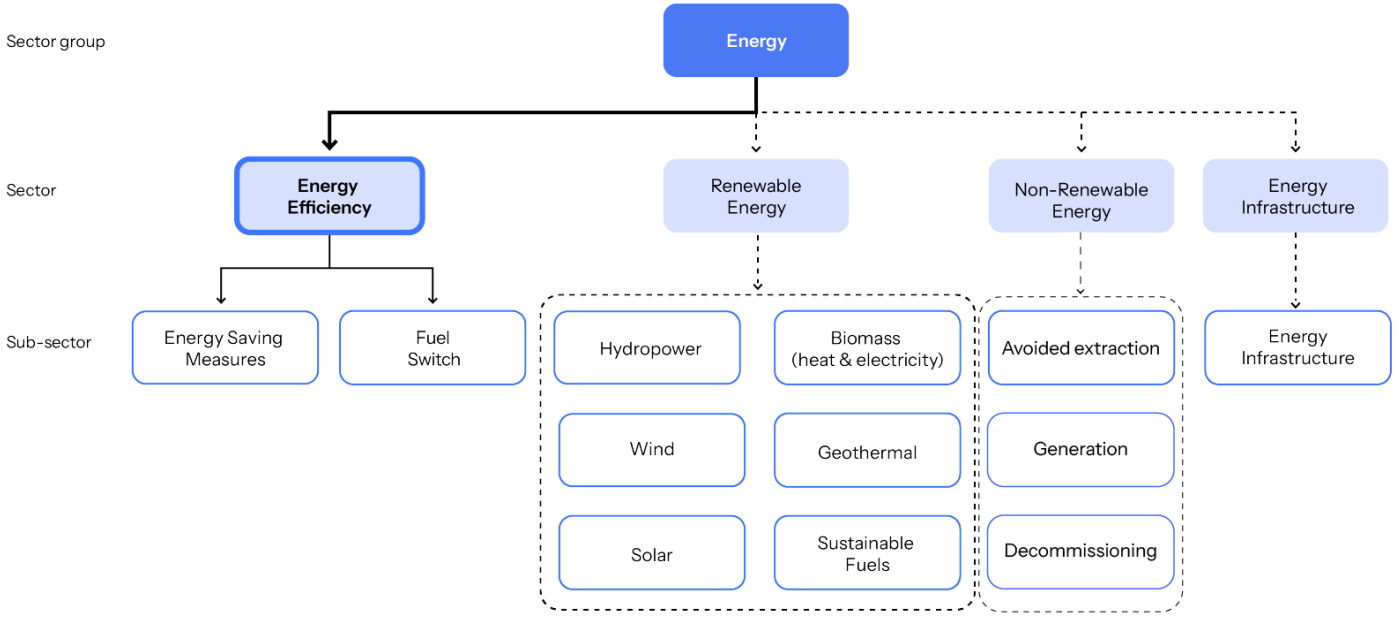


Figure 1. The Energy sector group within BeZero's Sector Classification System.

Additional sub-sector qualifiers for Energy

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 attributes for Energy projects.

Additional qualifier	Options	Definition
Grid connection	Grid-connected	Projects connected to an existing centralised power grid
	Off-grid	Projects that operate independently of an organised electrical power grid
Grouping	Grouped	Projects that span multiple project sites in a given area
	Un-grouped	Projects that consist of a singular project site
Scale	Small-scale	Project sites with a rated capacity of 10 MW or less
	Large-scale	Project sites with a rated capacity over 10 MW
Fuel source	Gas	Projects that use gas for their fuel source
	Oil	Projects that use oil for their fuel source
	Coal	Projects that use coal for their fuel source
	Biomass	Projects that use (waste) biomass for their fuel source
Type (wind)	Onshore	Projects that use onshore wind power; generally a more mature technology with lower capital costs and less preferential capacity factors relative to offshore wind

	Offshore	Projects that use offshore wind power; generally a less mature technology with higher capital costs and more preferential capacity factors relative to onshore wind
Type (solar)	Photovoltaic	Projects that use solar energy to generate electricity, generally made of either monocrystalline silicon, polycrystalline silicon, or thin film materials
	Thermal	Projects that use solar energy to generate heat
Type (hydro)	Run-of-river	Projects which do not involve the construction of reservoirs to generate electricity and rely on an existing river system, typically with less infrastructure requirements, at a smaller scale, and less likely to be exposed to methane-related concerns
	Reservoir	Projects which involve the construction of reservoir systems to generate electricity, with greater infrastructure requirements, larger scale and more likely to be exposed to methane-related concerns
Type (biomass)	Electricity	Projects that use biomass to generate electricity
	Heat	Projects that use biomass to generate heat
Feedstock	Bagasse	Projects that use bagasse, the dry pulpy fibres that remain after juicing crops such as sugarcane, as their primary feedstock
	Landfill gas	Projects that use the methane emissions from landfill sites as their primary feedstock
	Rice husks	Projects that use rice husks as their primary feedstock
	Wood waste	Projects that use wood waste as their primary feedstock
	Renewable municipal waste	Projects that use renewable municipal waste as their primary feedstock
	Other vegetal and agricultural waste	Projects that use other vegetal and agricultural waste as their primary feedstock
Type (sustainable fuels)	Biofuels	Projects that involve liquid fuels derived from sustainable biomass
	Green hydrogen	Projects that involve hydrogen derived from renewable energy
	Other	Projects that involve sustainable fuels other than biofuels and green hydrogen

BeZero Carbon Rating analytical framework and process for Energy

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, 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 are nested within the overarching ex post and ex ante methodologies. The overall rating definitions, risk factors and risk driver categories are common across all projects while the sector methodologies provide more detail on our sector-specific analytical approach.

This document provides an extension to our overarching rating methodologies. It presents BeZero's detailed analytical framework and process for Energy projects. It showcases the various parameters through which we assess risk to the carbon quality of these credits, and how this sub-sector implements 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 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.

In Table 3, we highlight sub-components of our assessment of additionality for Energy projects. In the sections that follow, we detail the key parameters that factor into each level of risk assessment.

Table 3. Sub-components of additionality assessed.

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

Activity analysis

Common practice

Common practice is a primary driver of our additionality analysis across the Energy sector group, and for Renewable Energy it is, alongside investment analysis, one of the two tests most commonly used by projects themselves. Our objective is to determine how pervasive the project's activity or technology is within its region and sub-sector, both with and without access to carbon finance. Where an activity would be practised as standard absent carbon finance, it is unlikely to be additional.

Projects typically approach this quantitatively, counting sites using similar technologies, of comparable size, in the same geography and regulatory environment, and generally excluding sites that have themselves accessed carbon finance. We make similar concessions, and for generation projects we express common practice as the technology's contribution to installed capacity or generation. We then assess it qualitatively, to capture what a mechanical count does not.

Establishing common practice. We conduct exhaustive literature review to unearth comparable programmes or interventions that may otherwise have been overlooked, and contextualise our findings with national, regional and technology-specific deployment trends drawn from the International Energy Agency, the International Renewable Energy Agency, Ember, national governments and regulators, and industry research. We also compare penetration in the host

country against comparator countries at a similar stage of energy system development. For demand-side projects the equivalent evidence is market penetration data for the relevant technology — national sales data disaggregated by product technology, or the emissions and energy reporting of institutions in the relevant end-use sector, including the inventories published by voluntary climate commitment programmes and the reporting platforms their signatories use.

Establishing how pervasive carbon finance is. Our internally curated database of projects registered under the major standards bodies collates capacity, technology and location market-wide, and so establishes how frequently comparable activities occur with and without carbon finance. We also evaluate the robustness of the additionality assessments that admitted those projects, drawing on peer-reviewed literature and on the benchmark and investment analysis data compiled by the Institute for Global Environmental Strategies. Where a very high proportion of comparable projects passed a methodological investment test, particularly against a benchmark applied uniformly across a whole market, the more plausible inference is often that the test does not discriminate between projects whose barriers are genuinely overcome by carbon finance and those for which it is supplementary. Where a methodology requires no common practice test, or admits projects to a positive list, the absence of a requirement does not remove the risk: where our own evidence shows widespread adoption, we treat additionality risk as elevated notwithstanding the methodology's silence.

Looking beyond a single point in time. We examine common practice from the project's conception through to the vintages assessed, including trends emerging after implementation. Project activities frequently follow a recent policy intervention — a new feed-in tariff, a new pipeline or terminal — and in those cases it is the data following the intervention, not the historical data, that reflects its significance; a purely retrospective test can miss the policy change that explains both the project and its contemporaries. Where implementation can be undertaken readily and repeatedly, the position at the moment of conception cannot settle the question. For energy saving measures projects crediting over the assumed lifetime of installed equipment, an end-user could have adopted the technology at any point within that lifetime, so additionality is interrogated periodically across the credited period rather than once.

Risk is highest where the technology is widely diffused or dominant in the market, where comparable activities proceed without carbon finance, or where the scope of the test has been narrowed to exclude genuinely comparable sites; and for demand-side projects, where the credited lifetime extends beyond the point at which the technology or a superior alternative becomes common or affordable. Risk is lowest where the baseline technology remains dominant throughout the credited period and any increase in project-technology uptake is itself plausibly attributable to the project.

A lack of common practice can support an additionality claim and may substantiate barriers, but is often not sufficient on its own to conclude on additionality — particularly in this sector group, where substantial non-carbon incentives are common. The caution runs the other way too: where an activity was previously prevented by a non-financial constraint since removed, such as the arrival of fuel supply infrastructure, its historical absence tells us little about the necessity of carbon finance.

Alternatives to the proposed project

This risk driver addresses the likelihood and extent of the alternative scenarios that would occur in the absence of the project. The most credible alternative is the counterfactual against which additionality is judged, and it informs the baseline we consider appropriate under Carbon Accounting.

The relevant alternatives differ by sector: for Renewable Energy, the suitability of the selected technology relative to others that could have met the same need; for Non-Renewable Energy generation, continued reliance on existing emission-intensive assets or the installation of a new one; for fuel switch, continuation of the incumbent fuel; and for energy saving measures, continuation of baseline practice by the end-user. The driver is interlinked with common practice and barrier analysis but requires a more nuanced approach, because characteristics specific to a project area can make regional or even local common practice a poor guide to what would have happened there. We therefore assess the credibility of each scenario in its own right.

Considerations include whether the project formed part of a grid expansion, and whether its affordability alone would have justified it. This matters particularly where a state proponent has its own incentive to reduce electricity costs. We compare the LCOE of the project against the credible alternatives, and consider whether it relies on a freely and domestically available resource rather than an imported or price-volatile fuel, which can make it the rational choice on security of supply alone. We also weigh the merits of the alternatives on grounds other than cost, such as dispatchability, alongside the cost and availability of the fuel already in use. For private investment, we assess whether a low LCOE combined with a guaranteed above-market tariff made the project attractive on its own terms.

Risk is highest where the project is itself the most credible counterfactual. It is lowest where a cheaper or more easily financed alternative existed, and the project's selection is hard to explain without carbon finance.

Financial Analysis

Investment analysis

Our objective is to determine whether a project's implementation and ongoing operation depend on carbon finance. For most Energy projects, carbon finance supplements primary revenues from the sale of electricity, heat or fuel to make the project viable relative to the likely alternative, and projects demonstrate this by reporting an internal rate of return, excluding carbon revenue, below a relevant benchmark and outside a sensitivity range.

We treat that test as a minimum requirement rather than a conclusion: an IRR is sensitive to a small number of key inputs and carries relatively high uncertainty, so slight variations can produce a figure unrepresentative of the project. Our analysis concentrates on the integrity of the inputs and the materiality of carbon revenue rather than on the reported result.

Corroborating the inputs. Where a project provides its own analysis we reconstruct it input by input and attempt to validate it, re-deriving credits issued per unit of energy and substituting a market-consistent credit price. We interrogate reported returns and payback periods, capital and

operating costs, assumed generation or energy saving, tariff and credit price assumptions, the discount rate, and the treatment of taxes and subsidies — cross-examining rigorously the role of major subsidies that may or may not have been included — against independent data sources, industry data, peer-reviewed research and in-house expertise. Asymmetric treatment of costs or revenues between the with- and without-carbon-finance scenarios is a common source of an unrepresentative result, so we test the two for consistency, and we read validation and verification reports for the validator's own observations on the realism of a project's assumptions. We screen methodologies for outdated or overestimated investment benchmarks and for subjectivity around future costs.

Benchmarking realised performance against forecast. Where documentation reports grid export or energy saving data, we compare realised output against the project's ex ante estimates and against the wider industry. Where it materially exceeds the forecast on which the investment case rested, and the project's sensitivity analysis does not span the deviation we observe, additionality risk rises.

The change in IRR that carbon finance introduces. The assessment should incorporate not only the IRR relative to a benchmark but the ΔIRR — the change carbon finance introduces — since together they better reflect the materiality of carbon revenue to the investment decision, particularly where the benchmark may not represent the true hurdle rate in that market. Where the IRR sits above the benchmark, the project likely reflects an attractive investment irrespective of carbon revenue. Where it sits materially below and the ΔIRR is large, carbon finance likely represents a revenue stream critical to the decision and to ongoing financial success; where it sits only immaterially below with a large ΔIRR, it could do, but the conclusion is weaker. Where the ΔIRR is small, neither the decision nor ongoing success is likely to have been contingent on carbon finance — and if the IRR is at the same time materially below the benchmark, that combination suggests the benchmark does not delineate the point at which an investment decision is actually made in that market. ΔIRR tends to be reported by older projects, generally those registered before 2013, and is less readily disclosed by more recent ones.

Composition varies systematically by technology, which opens scope for different interpretations across sub-sectors. Technologies with higher operating costs, such as bioenergy, tend to show weaker standalone economics and greater sensitivity to credit revenue; mature, low-operating-cost technologies such as solar photovoltaics tend to show the opposite. ΔIRR and the strength of non-carbon revenue are generally inversely related: the more generous the tariff, the less material carbon revenue is likely to be. These generalisations are drawn from the comparative literature on project economics under the Clean Development Mechanism, and each project is assessed on its individual merits.

Revenue materiality. Primary revenues and credit sales are typically parallel income streams, which allows direct comparison. We estimate carbon revenue from credit price information collated from periodic market reports, including sector-average price reporting from market intelligence providers, running scenario analysis across a range of reasonable price assumptions because realised prices diverge from published averages. We compare that against revenue expected from energy sales over the project's economic lifetime, on both a nominal and a discounted basis, using our curated database of international tariff structures and prices where tariff information is not directly available. Where the role of carbon finance is small, we generally find it unlikely to be the factor on which the investment decision was contingent — though this is not prescriptive, and small contributions can

prove crucial. The comparison remains necessary where a methodology deems a project automatically additional and no financial information is disclosed: we construct it from our tariff database, reported sector credit prices and the project's assumed emission factor, converting credit revenue into an uplift per unit of energy sold. A high tariff combined with a low credit price makes carbon finance a marginal revenue stream, from which we infer significant additionality risk.

Two sector-specific nuances affect this analysis:

- **Non-zero project emissions dilute carbon revenue.** For Non-Renewable Energy and fuel switch projects, credits issued per unit of energy depend on the emission intensity of the project scenario as well as the baseline. Where a renewable generator might issue a credit for each unit delivered, a gas-fired generator displacing the same baseline issues materially fewer, because its combustion emissions are netted off. Carbon payments are therefore systematically more diluted relative to broader revenues for these projects, and we take that into account in judging materiality.
- **For demand-side projects the rationale is a cost saving, not a revenue.** For energy saving measures projects, and generation projects using electricity for captive purposes, it is avoided energy cost rather than revenue that underpins the activity. We assess the viability gap between project and baseline activities and how it changes once energy cost savings and carbon revenue are taken into account, normalising the avoided energy cost onto the same per-tonne basis as credit revenue — using local energy prices and the emission intensity of the energy displaced — so the two incentives can be compared directly. Where cost savings significantly outweigh carbon-related incentives, carbon finance is unlikely to have enabled implementation. Where disclosure permits, we also assess net present value with and without credit revenue, since for retrofit and conversion projects the case often turns on whether the saving is sufficient to overcome the capital cost at all.

Performance and cost benchmarking. How a project's performance and costs compare with others indicates whether it is a weaker or stronger standalone investment. For generation projects the principal metric is the capacity factor, which levelises output against installed capacity and so allows comparison between sites of different sizes; a high capacity factor indicates a favourable resource and a greater volume of energy sold. We compare a site's annualised capacity factor against the distribution of comparable projects globally and the national average for the technology, alongside capital cost per unit of installed capacity benchmarked against project cost data published by IRENA and, where relevant, the quality of the resource at the site. Where a site performs strongly without a commensurately higher capital cost, the rationale for implementation was likely the resource rather than carbon finance, and additionality risk is elevated.

Tariff and revenue structure. The revenue structure supporting a project is part of the context of its conception. This sub-component applies to projects that sell energy; it is typically not applicable to energy saving measures projects, whose economics rest on avoided cost, and for which the equivalent analysis is the cost-saving comparison above. Electricity market economics are complex and market-specific, but our questions are consistent: how widespread and successful the tariff structure has been, how specific the tariff is to the project site, what price discovery mechanism produced it, and what interest the project or the auctioned capacity attracted.

Table 6. Tariff structures distinguished in our analysis.

Structure	Definition	Price stability	Competition
Feed-in Tariff (FIT)	A government-backed, long-term contract to purchase electricity from a producer at a specific price; a similar mechanism to a PPA but through governmental policy.	High	Low
Power Purchase Agreement (PPA) through private agreement	A long-term contract to purchase electricity from a producer at a specific price without market-based price discovery.	High	Medium
Power Purchase Agreement (PPA) through public auction	A long-term contract to purchase electricity from a producer at a specific price with market-based price discovery conducted through an auction.	High	High
Open market	Electricity is sold at a variable price depending on supply and demand at the time of generation.	Low	High

Given the disconnect between when energy projects accrue costs and when they generate revenue, most — though not all — sell through a FIT or PPA. By fixing the price for a defined period, these mechanisms generally improve the attractiveness of the investment.

Feed-in tariffs are generally priced to offer participating projects a reasonable return, which weighs against additionality. Where they do not, it is either because the scheme is underpriced or because a particular project faces heightened barriers, and we assess both. On the scheme: how rates are set, commonly banded by installed capacity and fixed for a defined tenor by the national regulator; industry research on whether they deliver a commercial return on equity and satisfy lenders; the sequence of revisions; the arrival of any supplementary or donor-funded mechanism layered on top, itself evidence that base rates were unattractive; and the share of comparable national installations that relied on carbon finance or that supplementary scheme rather than the base tariff. On the project: documented difficulty in raising debt finance against the tariff on offer is direct evidence of insufficiency.

Power purchase agreements offer a defined rate but are generally specific to a project rather than applying nationally, and our principal consideration is price discovery. Where a PPA was negotiated bilaterally we assess the terms achieved and the counterparty's position. Where price discovery occurred through auction, risk is elevated where the tender attracted substantial participation, implying the opportunity would have proceeded regardless of carbon revenue; where the winning bid undercut the prevailing grid tariff; where auctioned capacity was ultimately fulfilled; and where subsequent auctions cleared materially lower while the same proponents scaled their portfolios.

Open market sales expose a project to variable prices set by supply and demand at the time of generation. Such projects are less numerous in the VCM, but the resulting economic uncertainty can be a relevant consideration. Fuel price exposure is the mirror image for Non-Renewable Energy and fuel switch projects, assessed in the same frame: which party bears the risk of fuel cost escalation under the offtake arrangement, whether fuel prices are administratively set or subsidised, and whether conversion capital expenditure was offset by an uplift in the tariff received.

Prior consideration of carbon finance

This risk driver considers whether carbon finance was genuinely considered before implementation is foundational to the additionality of Energy projects. Without prior consideration, a project's ability to pass a financial additionality test, or to demonstrate barriers or a lack of common practice, may be redundant, because the activities were already occurring in a business-as-usual scenario.

We compare the date of the project's design documentation against the timeline over which capacity was commissioned or equipment deployed. Some elapsed time is reasonable; a large lapse is evidence that activities proceeded without consideration of carbon finance. This is especially material for grouped projects, where capacity is added over time: where a significant proportion was already installed and operational before carbon finance was contemplated, that portion at least is likely to have proceeded regardless, even if later additions did not. We also screen the methodology's requirements here, since they differ, and the absence of a requirement does not remove the risk.

Risk is highest where there is no evidence of prior consideration and the implementation timeline indicates activities preceded any engagement with the carbon market, and lowest where contemporaneous evidence shows carbon finance was integral to the investment decision when it was taken.

Barrier analysis

Barrier analysis takes account of the variables that impede a project's implementation, which a project may or may not disclose and which may fall inside or outside the project boundary. We assess not only whether those barriers exist and their scale, but the extent to which carbon finance actually alleviates them. The second question is pivotal, because some barriers are unrelated to what voluntary financing can confer. These challenges are varied and we do not apply a fixed checklist. The analysis is driven by data, academic literature and industry reports.

Table 5. Potential barriers that may impede a projects implementation

National barriers	Barriers to energy investment often exist at national level and can substantiate claims of additionality. We conduct in-depth literature review of a country's energy environment and rely on independent forms of national classification, an example being the United Nations' least developed countries — low-income countries confronting severe structural impediments to sustainable development. Other national barriers include poor transmission and distribution infrastructure, which may disincentivise investment in grid-connected generators, and poor integration of variable renewable generation, which may cause curtailment and forgone revenue.

	Relevant evidence includes the proportion of generated electricity ultimately paid for by an end-user, which combines technical losses with non-payment; multiple tariff rates that prevent cost-reflective pricing; rural electrification rates from World Bank energy access data; the rate of capacity addition preceding the project, from IRENA; and the share of assessed national resource potential actually exploited. In higher-income countries, tariffs, bill payment and transmission losses are generally not primary concerns.
Investment barriers	Renewable generation projects incur most costs as initial capital expenditure with comparatively low operating costs — the inverse of conventional fossil generation. Lifetime totals may be comparable, but the higher upfront requirement must be financed, which is harder in developing or low-income economies that lack the financing mechanisms of more developed markets and are perceived as riskier; we consider how access to carbon finance, an external revenue stream typically denominated in US dollars, assists a project in raising that capital. Non-Renewable Energy generation sits closer to the fossil cost profile, so this barrier is correspondingly weaker and the financial case turns more often on fuel cost and offtake terms. For demand-side projects the barrier appears differently: cost savings give end-users a strong incentive to act, countered by a lack of upfront capital. We assess this by end-user class, since a household faces a longer payback and a weaker absolute saving on an efficient lighting or appliance purchase than an industrial user, who is also more likely to hold the necessary capital already. A specific objection follows, which we address directly: because carbon revenue is received on a results basis, after installation, it cannot by itself relieve an upfront financing barrier. Where a project structure resolves this — for example by engaging counterparties who bear the upfront cost and are compensated from subsequent credit sales — the barrier can legitimately be said to be alleviated. Where it does not, the claimed barrier and the claimed remedy do not connect
Technical and operational barriers	Technological and operational challenges may prevent implementation where investment and financing are insufficient — access to technical expertise being one example, which a formalised structure such as the carbon market may facilitate. Where unfavourable climatic events present a reasonable threat, a project may require safeguards at the expense of greater capital costs or more frequent downtime; we assess the frequency and severity of the hazard using historical event records such as storm track datasets, any precedent of damage to comparable assets nearby, and whether the response involved novel or immature engineering, which lends some weight to additionality given the associated complexity.

Other barriers.	We also consider social barriers, such as opposition from local stakeholders on amenity grounds where a site sits close to residents, and constraints on the availability of suitable sites. Where opposition is material, the question is what would resolve it and whether carbon revenue could fund that resolution: where compensating affected stakeholders would resolve the objection but is reported as unaffordable given industry margins, carbon finance is contextually relevant. Barriers may also be technology-specific within a country, and low penetration despite an established support scheme is itself evidence of one.

The decisive question in every case is whether carbon finance bears on the barrier identified. A barrier may be real but immovable by carbon revenue — a hard ceiling on exploitable resource, a shortage of suitable land, or a curtailment of fuel supply by a national utility that no plausible credit revenue could overcome. Establishing this often relies on evidence outside project documentation: national fuel supply and allocation studies, allocation decisions by state utilities, field- or basin-level production decline data, and the proponent's own public financial disclosures, including statements made in distress or insolvency proceedings. Risk is lowest where identified barriers are material, well evidenced and of a kind carbon revenue can plausibly relieve; and highest where the barriers presented are immaterial, or real but unrelated to what carbon finance can provide — in which case, if severe, they may undermine the project's viability case altogether.

Legal and policy

Our objective is to determine the extent to which the policy and political environment encourages or requires the project activities in the absence of carbon finance, considering the existence, relevance and effectiveness of the relevant policies. A very supportive policy environment can undermine a project's carbon efficacy; conversely, successfully operating in an unsupportive environment may reinforce it. We assess whether projects have benefited, or are eligible to benefit, from government incentives such as tax relief, grants and subsidies, and the market potential for the technology in the country. The driver is frequently material for Energy projects, and particularly for generation projects, because proponents are often state-run or state-owned enterprises.

Targets. Targets are an explicit means of observing the priority a jurisdiction affords a technology or activity. We consider the host country's Nationally Determined Contributions, and beyond them national, regional, sectoral and technology-specific targets set out in energy plans and multi-year development plans, and, for demand-side projects, energy-saving orders and consumption-reduction goals set at state or municipal level. We assess achievement against those targets over time, comparing stated capacity or consumption goals with outcomes reported by governments and independent institutions. Consistent achievement indicates a regulatory environment well suited to the technology, which questions the necessity of an additional revenue stream and raises additionality risk; under-achievement, particularly where the instruments intended to deliver the target demonstrably failed, supports additionality. Where a project received funding under a programme tied to a dated policy goal, we trace whether disbursements correlate with those goals, whether the site met them, and whether later funding phases overlap the crediting period.

Regulatory surplus. We interrogate whether laws, regulations, statutes, legal rulings or other frameworks require the project activities, directly or indirectly. For Energy projects this typically means regulation of the energy market: obligations on suppliers or generators to source a defined share from particular technologies, escalating share requirements, penalties for non-compliance, licensing regimes and their liberalisation, reform of state generation monopolies, priority allocation of scarce fuel, and mandated efficiency or fuel standards. Instruments short of a mandate matter: a target can be pursued vigorously enough that compliance-driven behaviour indirectly incentivises the activities, and a mandate may have been reasonably anticipated even where none existed — where an activity was strongly encouraged and an analogous regulated industry in the same jurisdiction was later mandated to do the same thing. Because instruments are frequently introduced, revised and withdrawn, we track those events — the introduction or removal of an accelerated depreciation allowance or of generation-based incentives, or a transition from administered feed-in tariffs to reverse auctions — against the deployment time series for the technology, to establish whether policy drove market interest.

Government effectiveness. The bearing of regulatory surplus on our rating is closely related to our assessment of government effectiveness, in which we analyse the implementation, enforcement and overall effectiveness of the relevant regulations and initiatives at national, regional and local level. Where regulations mandate project activities in combination with high government effectiveness, we consider additionality risk to increase, since the policy environment rather than carbon finance likely accounts for the project's existence. Success may be gauged as a relative metric — over- or under-achievement of stated targets — or an absolute one. Policy language is frequently obtuse and the practical significance of an instrument to an individual project is often not evident from its text, so each policy is assessed with input from analysts experienced in the jurisdiction, and we are explicit where its status or effect is uncertain.

Investment landscape and national classification. We assess investment opportunities and activities related to climate change mitigation and adaptation in the host country, and the risks attaching to investment there, including policy and regulatory risk, market volatility and the physical impacts of climate change. These are assessed relative to a baseline, which may itself indicate the degree of government encouragement. Alongside this we use a country's national classification: a classification as a Least Developed Country is relevant to investment risk, and we typically consider less additionality risk to attach to LDCs, since the policy environment is less likely to deliver the activities itself. A high-income country generally presents greater risk, since alternatives to carbon finance for overcoming barriers are more likely to exist.

Risk is highest where activities are directly mandated, or heavily supported through incentives the project is eligible for and has drawn upon, in a jurisdiction where policy is effectively enforced — the case of a project entity facing limited barriers to entry, such as high market penetration of its technology, and receiving government assistance. It is lowest where no supporting policy or programme exists, where the project is ineligible for available support, or where the policy environment actively impedes the activities.

Carbon Accounting

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

For most Energy projects the premise underlying avoided emissions is straightforward: a quantity of energy is produced, or a quantity of demand avoided, displacing energy that would otherwise have been supplied by more emission-intensive means. Two variables dominate our assessment — the quantity of energy generated or saved, and the emission intensity of the baseline fuels and technologies displaced — and a third applies wherever the project scenario itself emits.

The distinction between near-zero and material project emissions runs through this section. Renewable Energy generation projects typically have near-zero marginal emissions, so their accounting turns almost entirely on output and baseline intensity; but near-zero is not zero, and backup generation, reservoir methane and lifecycle emissions can be material. Non-Renewable Energy and fuel switch projects have material project emissions by construction, and their credits represent the difference between two emitting scenarios. Energy saving measures projects present a third case, in which the credited quantity is the difference between a modelled baseline and metered actual emissions, so project emissions and monitored emissions are the same quantity.

We also apply an explicit boundary rule. Emissions arising within the project boundary as a consequence of project activities are assessed under Project scenario; emissions arising outside it are assessed under Leakage accounting. Where a source could be characterised either way, we assess it once and state where.

Table 6. Sub-components of our carbon accounting assessment.

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

Our assessment 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 energy generated or saved over the rated vintages, the emission intensity applied to it, and the resulting gross emissions reductions; we then account for the project's own emissions and any leakage deduction to arrive at claimed net reductions, and reconcile that against the credits actually issued.

We then construct the equivalent quantity on our own terms. Where the risk drivers below lead us to a different view of the counterfactual, of the emission intensity properly applicable, of the project's own emissions, or of the appropriate leakage deduction, we quantify what our assumptions imply and arrive at a BeZero view of net emissions reductions. The proportion of 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.

Quantification is attempted wherever the evidence permits, including where we conclude that a project's accounting is conservative rather than aggressive. Non-trivial assumptions are unavoidable, particularly in establishing an alternative counterfactual or substituting an undisclosed parameter; 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

Our objective is to determine whether the project's baseline reflects the most likely counterfactual and is quantified accurately or conservatively, and where it does not, to quantify the difference. Baselines in this sector group fall into two classes with very different risk profiles.

Baselines derived from metered energy flows. For most generation and fuel switch projects, an equivalence is drawn between energy flows in the project and baseline scenarios: absent the project, an equivalent quantity of energy would have been supplied by existing plant or new capacity. The baseline quantity is therefore anchored to the project's directly metered output or fuel input. Because output is directly measured and often corroborated by verifiers against invoices, we find this variable is likely to be accurate and unlikely in itself to introduce risk. Our attention falls instead on the monitoring arrangements, assessed under Project scenario, and on the emission intensity applied, assessed under GHG conversions.

Two situations break the assumption of a linear relationship between project and baseline energy flows, and in both we assess whether the methodology provides safeguards, how they are applied, and whether they are contextually appropriate:

- **Transmission and distribution losses.** Particularly for off-grid and mini-grid systems, energy metered at generation does not equate to energy displaced at the end user. Where a project applies a methodologically prescribed default discount, we compare it against national loss data from the relevant utility and regulator and the series published by the International Energy Agency and World Bank, recognising that national values reflect the incumbent network and may overstate losses in newer, better-maintained systems. We regard an estimated loss deduction as good practice, but a default not derived from project-reported values leaves residual uncertainty in either direction.
- **Rebound effects.** Where a project assumes all energy generated or saved would otherwise have come from the baseline source, we test that against evidence on end-user consumption following installation. Peer-reviewed investigations of comparable installations have found consumption increasing afterwards; causality is difficult to establish, but reduced energy costs plausibly weaken the incentive to conserve. Where this occurs, a portion of project-scenario consumption would not have existed in the baseline at all, and crediting it results in over-crediting. This applies most directly to demand-side and captive-power installations serving discretionary consumption.

Modelled and forecast baselines. For energy saving measures projects, and any project crediting against a projected rather than observed counterfactual, the baseline reflects a modelled trend. Because a without-project scenario is by design not observable, a forecast baseline should be conservative: built from historically representative values, with implicit safeguards against trends that may emerge later. For energy saving measures projects this generally requires that documented

exogenous efficiency improvements are accounted for, so the project is not credited for savings the market would have delivered anyway. For avoided extraction and decommissioning projects, this may require detailed modelling and estimation of fossil fuel volumes and associated emissions in the baseline. Our assessment turns on three questions.

How the historical period was treated. Where a baseline is the mean of a multi-year historical window, we examine whether production or consumption was already trending down across that window through exogenous activity. Averaging weights an early high-consumption year equally with a late low-consumption one, inflating the baseline. Our preferred construction — and, where a documented business-as-usual improvement factor exists, what we regard as best practice — is to apply that factor to the final year before the project start, carrying the difference through to our view of net reductions.

Whether exogenous drivers have been normalised. Facility consumption is sensitive to variables unrelated to the project, of which weather is the most common: heating and cooling demand track degree days, and a baseline period colder or hotter than the crediting period will misstate the saving. Where a project does not normalise for temperature sensitivity and we can demonstrate a strong relationship between its emissions and degree-day data for its location, we compare conditions across the two periods and treat the un-normalised baseline as a source of risk. The same applies to other documented exogenous drivers, such as production volume or occupancy.

Which counterfactual the baseline represents. For generation projects several candidates may be available: the intensity of prospective new generators the project renders unnecessary or downsizes (the build margin); the combined effect on existing dispatched and prospective new generators (the combined margin); and the intensity of the specific generator most likely to have been installed instead. Selecting the least emission-intensive credible candidate is conservative and we regard it as best practice. Where a project selects a more generous candidate we quantify what the alternatives imply and characterise over-crediting in proportion to the difference. We also test how the selected baseline moves over time, since a value conservative at determination may not remain so across a crediting period.

Risk is lowest where the baseline is anchored to metered flows, the counterfactual is the least emission-intensive credible candidate, and modelled elements are demonstrably conservative and normalised. It is highest where a modelled baseline rests on an unrepresentative historical window, is not normalised, ignores documented exogenous improvement, and assumes a counterfactual more emission-intensive than the evidence supports.

Project scenario

The accuracy of claimed emission reductions rests in part on a project measuring and reporting its own energy flows and emissions correctly. This driver applies to all Energy projects and is where emissions arising within the project boundary are assessed. Its monitoring components apply to ex post ratings; for pre-issuance ratings the equivalent questions are addressed through the project execution and monitoring assessments in our Ex Ante Rating Methodology.

Monitoring and metering. Since energy inputs and outputs are accounted for using directly metered values, and output is often corroborated by verifiers against invoices, these variables are generally likely to be accurate. We nonetheless assess the arrangements producing them: the accuracy class of billing meters; the presence of dual metering, where generator and offtaker each

maintain a meter reconciled against the other within a defined tolerance; and the calibration and replacement schedule, including whether it is triggered by elapsed time or observed discrepancies. Where possible we corroborate metered output against external sources — output separately disclosed by the owner or operator, institutional or corporate emissions disclosures covering the same facility, or reporting maintained by the administrator of a voluntary climate commitment programme the site belongs to. Independent recording of energy imports and on-site fuel combustion, maintained for purposes unconnected with the project, is particularly strong corroboration. Close agreement between independent series reduces risk; material divergence, or an absence of disclosed values where our other evidence indicates activity, elevates it.

Emissions from the project's own operation. For Renewable Energy generation projects, project emissions typically arise from fossil fuel use in backup generation when the plant cannot meet its own parasitic demand. These are usually immaterial relative to avoided emissions; where they are not, we quantify them and carry them through to our view of net reductions.

For Non-Renewable Energy and fuel switch projects, project emissions arise from combustion of the project fuel and are central to the accounting. The monitored fuel quantity is converted using the fuel's net calorific value and emission factor, and we interrogate both: whether they are monitored for the fuel actually delivered to the plant, at what frequency, and by whom. Independent monitoring by fuel suppliers at high frequency captures material fluctuations in fuel quality and reduces risk; reliance on a single generic value does not. We benchmark the values used against IPCC defaults and comparable values reported in academic literature and by credible institutions. Unexplained divergence in a direction favourable to issuance raises risk.

Reservoir methane. Reservoir hydropower projects flood carbon-rich land, creating an anaerobic environment in which microbial decay produces methane. Given methane's global warming potential this can be a substantial source, specific to the reservoir qualifier within the hydro sub-sector; run-of-river projects are generally not exposed to it. The relationship we work with, established in the peer-reviewed literature, is that methane emissions per unit of energy generated are inversely related to a site's power density — installed capacity relative to reservoir area — and we assess reported and estimated power density against it. Where a methodology requires a fixed deduction for projects within a defined power density band, we assess whether that deduction is contextually appropriate, noting that emissions from this source are likely to persist outside the band in which it is mandatory. Two factors aggravate the risk: tropical climates exacerbate methane release, and a low baseline grid emission intensity heightens the materiality of this source relative to emissions avoided.

Lifecycle emissions within the boundary. We consider emissions from the manufacture of project components, their transportation and distribution, installation in the project area, any associated land use change, and end of life. Where these fall within the project boundary they are assessed here; where they fall outside it they are assessed under Leakage accounting, and the same source is not assessed twice. Where possible they are quantified and compared against the emission savings on which issuance rests. Lifecycle intensity varies materially by technology and, within a technology, by component chemistry and manufacturing route — thin-film cadmium telluride photovoltaic modules, for instance, carry materially lower manufacturing emissions than silicon-based modules — and we use academic sources reporting lifecycle emissions per unit of energy produced to establish a credible range for the technology in question.

Risk is lowest where energy flows are directly metered under robust, independently reconciled arrangements, fuel-specific parameters are monitored and consistent with published values, and project emission sources are identified and accounted for. It is highest where monitoring is opaque or unreconciled, conversion parameters are generic and favourable, and a material source — backup generation, reservoir methane, or the lifecycle emissions of an emission-intensive manufacturing route — is excluded.

GHG Conversions

This risk driver addresses the parameters that convert a monitored quantity of energy into avoided emissions, and whether they are appropriate. For grid-connected generation the dominant parameter is the baseline emission intensity of the grid; for other projects it is the emission factor of the displaced fuel; and for all projects the global warming potentials used for non-CO_2 gases matter. Where a parameter is not appropriate, we quantify the effect on issuance.

Baseline grid emission intensity. For grid-connected projects we consider the use of combined margin emission factor (EF_{CM}) as more appropriate than the use grid average emission factors. Combined margin emission factor captures the dual effect of the project's output on the grid: existing marginal generators reducing production (the operating margin, EF_{OM}) and prospective generators no longer required or built to a reduced specification (the build margin, EF_{BM}). It is calculated by quantifying the two components independently and taking a weighted average, generally using methodology-prescribed default weights.

The parameter carries structural risk because, unlike metered generation, it is an estimate: insufficient grid information and the complexity of power systems mean observations at one site cannot simply be translated to another, so the factor rests on underlying assumptions and average grid data. Our assessment begins with the appropriateness of those assumptions and how well each component reflects the sources theoretically displaced, informed by review of power sector trends, national datasets, peer-reviewed literature and industry reports. Four lines of analysis follow.

Weightings. The operating margin is generally more emission-intensive than the build margin, so the weighting between them determines the resulting factor, and issuance is directly proportional to it. We model the combined margin as a function of the build margin weighting across its full range and assess where a project's chosen weights sit relative to defaults. A deviation that depresses the project's own factor is conservative relative to its peers; a deviation the other way requires justification.

Alignment with current understanding. Default weightings rest on the non-dispatchable character of the relevant technologies. Peer-reviewed research has argued that, while dispatchability determines which baseline sources are displaced, the weight properly attributable to the build margin is better described by a site's capacity value — the reliability of its generation at peak grid load — since a project's effect on the need for new capacity is a function of the firm generation it provides. We assess this where the evidence permits, recognising that capacity values are site-specific and often difficult to determine.

Static versus dynamic application. Projects frequently derive a factor from historical grid data preceding implementation and apply it statically across the crediting period, which overlooks trends emerging within that period. We assess how the applied factor tracks marginal grid trends reported by governments, independent institutions, industry research and academic literature. The error runs

both ways: where a grid decarbonises, a static factor overstates reductions, and the overstatement grows through the crediting period; where a grid becomes more emission-intensive, it understates them. We also assess whether the methodology required renewal at intervals, whether it occurred, and whether the interval is frequent enough to capture material change.

Continuity across sources and methodological options. We test sensitivity by comparing continuity across the options available within a methodology — the simple, simple adjusted, dispatch data analysis and average approaches to the operating margin — and against values determined by other bodies, including national ministries and regulators and the harmonised default grid factors published by the International Financial Institutions Technical Working Group. Continuity suggests the underlying assumptions are appropriate; divergence in which the project's value is the more liberal suggests over-crediting risk. We compare like with like: a harmonised international default may rest on more top-down data than a national regulator's estimate for the same grid, and a factor published specifically for intermittent generation is not the same object as a general grid factor.

Other conversion parameters. Where a project does not convert against a grid factor — heat and liquid fuel projects, off-grid projects, and fuel switch projects displacing a specific fuel — we assess the emission factor and net calorific value of the displaced and project fuels against academic literature and values reported by credible organisations, and evaluate any justification for divergence. We also screen the vintage of the global warming potentials used for non-CO_2 gases such as methane and nitrous oxide against the latest scientific consensus in the most recent IPCC assessment report, running scenario analysis to isolate each gas's effect on issuance where outdated values are used: an understated methane potential understates a project's own emissions and creates over-crediting risk, while revisions to other gases may be immaterial or offsetting.

One scope limitation is worth stating. Electricity projects are the most numerous in this sector group, but the Energy sectors also encompass heat and liquid fuels, and not all electricity projects are grid-connected. For these the combined margin framework does not apply and we rely on academic literature and industry reports to attest baseline fuel sources and their emission intensity. That analysis is more constrained than the grid-connected case, because comprehensive operating and build margin data do not exist for these energy forms.

Risk is lowest where the applied factor rests on appropriate, granular data, is corroborated by independent sources and methodological options, tracks observed trends across the vintages assessed, and uses current global warming potentials. It is highest where a static factor materially diverges from observed trends in the direction favourable to issuance, where weightings or methodological options are selected without justification, and where outdated conversion parameters inflate the credited quantity.

Leakage accounting

Leakage is essential to a comprehensive evaluation precisely because projects in this sector group very frequently treat it as negligible, or neglect it altogether. Where we identify sources of leakage, we seek to quantify and aggregate them, and contextualise the total against any deductions the project has made.

Activity displacement

Activity displacement arises where emissions are displaced or transferred outside the scope of the project as a consequence of its activities. We interrogate whether the scope of a project's emission reduction claim is sufficiently broad to account for all of its impacts.

Displacement across emission scopes. Where crediting rests on reducing direct (scope 1) emissions, those reductions may have been achieved partly by increasing emissions the project does not account for — most obviously by substituting purchased energy for on-site combustion. We therefore examine net emissions trends across direct (scope 1), purchased-energy (scope 2) and value-chain (scope 3) emissions over time. Where scopes 2 and 3 fall alongside or faster than scope 1, displacement is less likely; where a decline in scope 1 is offset by increases elsewhere, the risk that credited reductions have shifted has more credence. This is a deliberately simple test: increases in other scopes may correlate with trends independent of the project, such as growth in the facility or its activity, and we assess other causes before concluding.

Emissions lock-in. For Non-Renewable Energy generation and for fuel switch projects transitioning to another fossil fuel, leakage may take the form of locked-in emissions: an asset that, over its technological lifetime, becomes more emission-intensive than the alternative that would otherwise have been implemented. Where carbon finance facilitated a transition to a lower-carbon fossil fuel, and the cost of renewable alternatives such as solar photovoltaics has been declining steeply, a renewable option might instead have been implemented within the lifetime of the baseline technology, in which case the project may have locked in emissions above another realistic baseline. We therefore consider alternative baselines and relevant trends both inside and outside the crediting period, comparing the emission intensity of the project technology against the trajectory of the grid's build margin across the vintages assessed and forward over the asset's remaining physical life, noting gaps in the series rather than interpolating across them. Risk is elevated where the grid is decarbonising quickly enough for the asset's intensity to cross above it — a crossover that conservative input assumptions in the project's own baseline can bring forward — and where the asset's remaining lifetime extends well beyond the crediting period. These are the circumstances in which a project may avoid emissions in the short term while causing net emissions over its lifetime.

Upstream emissions outside the boundary. Where a project's fuel or technology carries emissions generated outside the boundary — extraction, processing, liquefaction, transport and distribution, including fugitive emissions, and any associated land use change — we assess whether they have been accounted for and, where not, whether the exclusion is conservative. Projects sometimes argue that upstream emissions are lower in the project scenario than the baseline, so no deduction is required, or that leakage is net positive. We test such arguments against the literature rather than accepting them: in the case of a switch away from coal, the claim that avoided fugitive methane from coal mining exceeds all fugitive emissions from gas production, liquefaction and handling must contend with evidence that fugitive emissions from coal mining are substantially independent of production and do not cease when production falls, since emissions from abandoned mines are likely to remain flat or grow. Where that is so, excluding the project fuel's own upstream emissions is unlikely to be appropriate, and including them can materially reduce the reduction claimed.

Downstream emissions and enabled activity. We consider emissions arising downstream, including from the use of the energy supplied and from end of life. Of particular relevance are cases where new supply enables emitting activity that would not otherwise have taken place — for example where an

isolated system with a limited transmission radius makes local industrial or extractive activity newly viable, with its own direct and land use emissions. Where this is plausible we establish what activity has developed within the system's reach since the project began operating, comparing concessions, permits or licences granted in the vicinity before and after the project start date, and assess whether it is attributable to the availability of the project's energy.

Risk rises with the size of the unaccounted displacement relative to claimed reductions, and is lowest where the project's boundary is broad enough to capture its material consequences, or where the sources we identify are demonstrably immaterial.

Market leakage

Market leakage occurs when project activities alter the supply and demand equilibrium, such that shifting market dynamics increase emissions elsewhere and offset those avoided. We assess whether any degree of market leakage is likely to be occurring as a result of the project's activities and, if so, whether its deduction is sufficient to account for it. Two mechanisms arise in this sector group.

For projects that consume a fuel, using that fuel may render it unavailable for other activities, which may then be pushed towards a more emission-intensive substitute. This is most material where a project's fuel demand competes with another sector being encouraged or mandated towards the same fuel, and domestic production is failing to keep pace with demand. We assess the credibility and likelihood of that scenario using national production and demand data and the policy framework applying to the competing sector, together with the existence and adequacy of methodological and project-specific safeguards.

For projects displacing fossil fuel consumption on a grid, the mechanism runs the other way: reduced demand could in principle reduce prices and increase consumption elsewhere. Similarly, for projects reducing the supply of fossil fuels, market effects are likely to occur. Our approach in these cases involves the use of supply and demand elasticities to calculate leakage risk.

Risk is highest where competition for a constrained fuel is documented, the substitute available to the competing activity is materially more emission-intensive, and the project has made no deduction; and lowest where its deduction is commensurate with the leakage our analysis implies.

Permanence

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

Our analysis considers the permanence of climate benefit as it relates to the contractual commitment of a given project and its credits. A commitment period is the period over which a project has undertaken that the abatement it claims will endure; it differs from the crediting period, during which reductions are eligible for issuance as verified credits. Assessing a credit's permanence risk therefore requires identifying that period and whether the credit faces reversal risk within it.

Permanence is a materially less significant risk factor in this sector group than in our nature-based sectors, for a structural reason: these projects issue avoidance credits, and the abatement claimed is not held in a biological or geological stock that can subsequently be released. The natural and anthropogenic reversal risks that dominate permanence analysis for land-based projects — fire, extreme weather, pests and disease, encroachment, loss of land or carbon rights — do not generally apply to an operating power plant or a completed retrofit.

Table 7. 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 stock integrity refers to the relative permanence of the carbon stocks saved or sequestered by the project activity: where a project conserves carbon stored in an impermanent form, natural phenomena may reverse the benefit. Energy projects do not typically conserve carbon in this way, and this risk driver is typically only applicable to avoided extraction and decommissioning projects.

Projects crediting the early decommissioning or avoided extraction of fossil-fuelled assets create a benefit contingent on the asset remaining out of service, so a permanence risk arises in principle if it were returned to service within the commitment period. When we rate such projects, we assess the legal and contractual mechanisms preventing return to service, their durability over the commitment period, and whether the asset has been physically retired in a manner that makes reinstatement impractical. For avoided extraction projects, we may also consider the physical risk of extraction or leakage elsewhere. For example, the risk of subsurface migration of natural gas after an extraction well has been plugged.

Forward crediting structure

Some projects issue all of their credits upon validation, because the project activity is completed in the initial year of operation, which is treated as the reporting period. In our view the actual emission reductions may not all have been achieved at that point, depending on the activity and its emission profile across the crediting period. Given that discontinuity we may assess increased permanence risk, on the basis that reductions may not proceed as modelled and some credits may therefore not represent achieved reductions. Note that forward crediting structure also affects our considerations of additionality and carbon accounting, under the appropriate risk drivers.

Updates and reviews

Version number	Date	Description
1.00	22/03/24	Initial release
1.01	03/10/24	Clarification on additionality as a limiting factor
2.0	17/02/25	Updated risk factor framework
2.01	05/03/25	Update to sector classification
1.0	27/10/26	Formatting updates, edits and revisions to align with ESMA regulatory requirements. Consolidation of separate Energy Sector methodologies into single Energy Sector Group Methodology

Disclaimer

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