

Public Consultation – Consequential Electricity-Sector Emissions Impacts

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1 Letter from the Chair of the Independent Standards Board

Dear Stakeholder,

I am delighted to welcome you to the first public consultation within the context of the updates being made to the corporate suite of GHG Protocol standards.

Collectively, these consultations focus on scope 2 as well as some additional topics which are set to inform the Actions and Market Instruments work. It is the result of a thoughtful, diligent and collaborative process involving the Scope 2 Technical Working Group (comprising a range of experts with diverse perspectives and experience) as well as continuous engagement with the Independent Standards Board in its role as independent arbiter on the GHG Protocol standards work.

Public consultation is a critical tool in shaping and strengthening standards, and in my role as Chair of the Independent Standards Board, I would like to thank you for your engagement and participation. I very much look forward to receiving your input, enabling us to progress towards the future Scope 2 standard.

With warm wishes,



Alexander Bassen
Chair, Independent Standards Board



2 Background, objectives, and scope

Public consultation is a critical component of GHG Protocol's [Standard Development and Revision Procedure](#), providing an opportunity for all stakeholders to contribute feedback on proposed revisions to GHG Protocol standards and guidance. It is one step of a broader process which is designed to support the development of robust, credible and trustworthy standards, leveraging the insights and expertise of stakeholders with a multitude of perspectives. This consultation constitutes the culmination of a process started in November 2022, with an [initial public consultation](#) including four surveys covering the suite of corporate standards. GHG Protocol received over 400 submissions to the scope 2 survey in particular, which are summarized in this [overview](#). This input also served as a starting point in the development of the [Scope 2 Standard Development Plan](#).

The present consultation period focuses on two distinct, but interrelated areas:

- **Scope 2 inventory topics** (*separate consultation document*)
- **Consequential Electricity-Sector Emissions Impacts** - Materials to inform the GHG Protocol's work on Actions and Market Instruments (AMI) (*this document*).

To access the survey link and other consultation materials please see this page: [GHG Protocol Public Consultations | GHG Protocol](#)

Topics to inform Actions and Market Instruments work

This consultation includes materials to inform the GHG Protocol AMI work, which is developing standardized, sector-agnostic requirements for quantifying and reporting GHG impacts of actions. This AMI work is expected to cover avoided-emissions methods that estimate the system-wide effects of clean-energy procurement and investment outside corporate inventories. This consultation invites targeted electricity-sector input to support AMI's cross-sector work, while keeping the separate scope 2 inventory consultation focused on location-based methods (LBM) and market-based methods (MBM). Publication and effective dates for Scope 2 and AMI are intended to be coordinated so that any new LBM/MBM requirements take effect alongside complementary AMI outcomes.

For further background on the work leading to this consultation please refer to Section 3 (Overview of the Consequential Accounting Methodology Development Process).

Scope 2 Inventory

A separate consultation document covers proposed updates to the location-based and market-based methods and related feasibility measures (Scope 2 Phase 1 consultation topics).

Outline of this document

Sections 5-9 of this document outline the topics for consultation. Each section includes:

- Background information on relevant topics
- Consultation Questions designed to elicit specific, actionable feedback.¹

Participation and next steps

¹ Please note that questions in this document are for reference only. All questions must be answered through the official Public Consultation online form which may be accessed directly on the main Scope 2 Public Consultation webpage.

For each consultation, stakeholders are encouraged to review the documentation, any proposed updates and rationale, as well as the consultation questions carefully and **submit their feedback via the online survey form on the consultation page** of the GHG Protocol website. The form will be open for submission for a **60-day period held between October 20 and December 19, 2025**. Please submit all feedback via the online survey form only. Feedback shared with GHG Protocol via other channels will not be considered as a part of the public consultation process.

For feedback on topics to inform AMI work only: Following the consultation period, GHG Protocol will prepare a public summary of all comments. This feedback will then feed into the on-going work of the AMI Technical Working Group, supporting the process of developing sector-agnostic guidance on reporting of emissions impacts from actions.

For both consultation areas, and in line with the [Standard Development and Revision Procedure](#), the Secretariat will analyze the number and variety of stakeholders that have submitted feedback to determine whether these are representative of all key groups. If the Secretariat determines that insufficient input has been received from any key stakeholder group(s), the Secretariat will proactively seek feedback from the underrepresented stakeholder groups.

Please note that the public consultation period is not a voting exercise. Following the conclusion of the public consultation period, all feedback submitted via the public consultation process will be evaluated in line with the [Standard Development and Revision Procedure](#) and weighed against GHG Protocol's decision-making criteria and hierarchy detailed in Annex A of [GHG Protocol's Governance Overview](#). The number of times a particular comment is submitted does not necessarily impact how the input will be considered in the AMI TWG going forward.

Transparency objective

In line with the [Standard Development and Revision Procedure](#), all feedback received during the public consultation period shall be made publicly available on the GHG Protocol website and shall, at minimum, identify the stakeholder type, sector, and region of the respondent. By participating in this consultation, you are agreeing to the terms in the Disclaimer and Notice of Rights for Voluntary Feedback Submission presented in the online survey form. This means that all feedback will be made publicly available, unless otherwise specified.

Anonymity: Transparency, accountability, and representation from key stakeholder groups are paramount to our standard development process and the future uptake of final standards. As such, the default is for all published feedback to be fully attributed to the respondent. In the exceptional circumstance that full attribution prohibits your ability to participate in the consultation, respondents may request that their name, organizational affiliation, and jurisdiction be redacted from the publicly available database of feedback. To request this anonymity, select the appropriate option in the demographics section at the start of the survey. If availing yourself of this option, it is the responsibility of the respondent to ensure that feedback does not contain any identifiable information. GHG Protocol will not redact or modify feedback outside of specifically identified fields when publishing feedback.

Confidentiality: In exceptional circumstances where good cause exists, a respondent may request that highly sensitive or confidential information not be made publicly available. This narrow exemption will typically only be granted for provision of commercially sensitive data or pre-publication research findings *in support of or as a supplement to feedback otherwise subject to public disclosure*. Requests for confidentiality are subject to review and not guaranteed. Therefore, all requests must be submitted via this [form](#) and approved in writing *prior* to submission of the affected feedback. Submission of sensitive or confidential information prior to receiving approval and instruction of how to submit the affected feedback may result in its publication.

To ensure sufficient time for review and adjudication of requests for confidentiality, potential respondents must submit their request prior to December 1, 2025. Requests after this date may be rejected. While GHG Protocol will endeavour to respond to requests as quickly as possible, response time is subject to the volume of requests. All feedback subject to disclosure must be submitted prior to the consultation deadline.

For additional insights on participation in the consultation, please see here: [GHG Protocol Public Consultations Now Open: Scope 2 and Electricity Sector Consequential Accounting](#).

3 Overview of the consequential accounting methodology development process

In February 2025 the Scope 2 Technical Working Group (TWG) formed a subgroup of electricity sector experts to develop methodologies for quantifying consequential emissions impacts for electricity projects. Its remit was to produce sector-specific recommendations and proposals for the Actions and Market Instruments (AMI) TWG. The subgroup's purpose was to recommend how organizations quantify and report consequential GHG impacts from their electricity actions. Its objectives were to: (1) provide focused, actionable recommendations to advance consequential accounting measures, (2) outline any additional disclosure elements needed to report consequential impacts, and (3) deliver a detailed proposal to the AMI TWG with calculation methodologies and reporting guidance. Following this work, the ISB directed further development of cross-sector avoided-emissions/consequential methods to continue under the AMI TWG, building on the subgroup's groundwork, before resuming sector-specific methodological development.

This public consultation on consequential accounting methods for the electricity sector first provides brief background on consequential accounting (general concepts, electricity-sector context, approaches, and decision-making considerations). It then focuses on gathering actionable feedback for the AMI workstream to inform a sector-agnostic consequential accounting framework, and ultimately the development of electricity sector-specific accounting methods.

The consultation is organized into four sections, each with context and targeted questions, presenting components developed by the Scope 2 TWG for feedback. These components include:

- A formula for quantifying emissions impacts from electricity projects
- Additionality tests and frameworks
- Marginal emission rate methodologies
- Combining build and operating margin emission rates

4 Background on consequential accounting

GHG Protocol Standards and Guidance documents have provided companies with tools to account for their emissions using both attributional and consequential accounting methods. **Attributional**, or inventory, accounting tracks GHG emissions and removals within a defined organizational and operational boundary over time. It is the primary method used by corporations and other organizations to report emissions from their operations and value chains. Its rules and procedures are detailed within several GHG Protocol standards and guidance including the GHG Protocol Corporate Standard, the Scope 2 Guidance, the Corporate Value Chain (Scope 3) Standard, and the upcoming Land Sector and Removals Standard.

At the same time, there is growing recognition of the value of **consequential**, or project, accounting. Consequential accounting estimates the impacts or changes in GHG emissions resulting from specific projects, actions, or interventions relative to a counterfactual baseline scenario. It is the primary method used to evaluate the emission effects of projects by comparing emissions and removals that happen in the project scenario with an estimate of what would have happened without the intervention. The project-based accounting approach evaluates system-wide emissions impacts of the project or intervention in question, without regard to the reporting company's operational or organizational inventory boundary. Its rules and procedures have been detailed in the [GHG Protocol for Project Accounting](#) and in sector-specific supplements such as the [Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects](#).

4.1 Consequential accounting in the electricity sector

Consequential accounting considers the difference in emissions caused by a decision relative to what would have happened otherwise. Instead of assigning a portion of existing emissions, it asks: what emissions were avoided or induced because of this action? These approaches are used in life-cycle assessment, impact evaluation, and policy design.

Consequential accounting has a unique value proposition in the electricity sector, by offering a way to capture the emissions impacts of changes on the grid. Due to electricity grid realities, changes in electricity consumption or generation do not impact the entire grid all at once, but rather specific electricity generators that are considered “on the margin”. These marginal generators are responsible for increasing or decreasing production in real time to react to grid signals and therefore changes in consumption or generation can be measured by using the emission rates of these marginal generators. Marginal generators also change throughout the day and year, so that the marginal generator at 10am might be different than the marginal generator at 7pm, and the marginal generator at 1pm in January might be different than the marginal generator at 1pm in July. Consequential accounting considers this and is therefore a useful tool for assessing the marginal impact of a decision to increase or decrease electricity consumption at a specific time and place.

Consequential assessments are especially important for electricity project development, since projects will have different emissions impacts depending on when and where they are deployed, and on their ability to deliver firm or intermittent electricity. A solar project deployed in California or Spain, on a grid that has a significant amount of existing solar resources, will not have the same emissions impact as a solar project deployed in Georgia or Poland, which are much more reliant on fossil generation facilities.

Importantly, decisions taken today that impact the electricity grid may initially only affect the set of generation resources that are on the margin, but over time will also impact how grids evolve decades into the future. For example, an intermittent source like solar may have a different long-term emissions impact than a firm source like geothermal, because their contributions to system reliability, curtailment, and capacity needs differ, even if both deliver electricity at the same time and location. Balancing these immediate impacts with long-term structural changes on the electricity grid is a complicated prospect, and one that will be addressed further in sections related to marginal emission rate methodologies.

4.2 Consequential accounting approaches for electricity

The aforementioned GHG Protocol document *Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects* provides a detailed step-by-step framework for quantifying impacts of electricity projects. In short, a project scenario is compared against a business-as-usual baseline scenario to evaluate emissions differences between the two. Projects that result in reduced system-wide emissions compared to their baseline scenarios are considered to have an emissions reducing or avoided emissions impact.

Other resources, such as UNFCCC’s [Consolidated Baseline and Monitoring Methodology ACM0002: Grid-connected electricity generation from renewable sources](#), utilize a similar methodological structure, with some differences in implementation approaches.

Key components of consequential accounting that differ from attributional accounting include:

- A system-wide rather than organizational assessment boundary.
- A lifetime quantification approach rather than an annual or year-over-year quantification approach.
- Demonstration of additionality: the concept that the project scenario differs from the baseline scenario. Projects that cannot demonstrate a difference between the project scenario and the baseline scenario do not result in GHG reductions.

4.3 Consequential accounting and decision-making

Because it communicates emissions impacts of discrete actions on the electricity grid, consequential accounting can offer a different set of decision tools for organizations interested in reducing emissions from electricity. For example, a decision to move forward with an onsite solar project at a manufacturing facility may look attractive under attributional inventory accounting, because this project will reduce the volume of electricity purchased from the grid, and therefore the scope 2 emissions associated with grid electricity.

However, a consequential accounting analysis may show that when the region already has significant solar supply, adding a new solar project may reduce output from existing solar projects, and therefore have a limited

emissions impact on the regional electricity grid overall. The opposite may also be true, and consequential analysis may show that the solar project displaces gas generation, meaning that the emission reductions may be even greater than the reductions reported in the organization’s attributional inventory.

Consequential accounting methods can be used alongside attributional accounting methods to help ensure that actions taken to reduce reported emissions also have positive impacts on system-wide emissions as well. For additional context, please see [“Inventory and Project Accounting: A Comparative Review”](#).

5 General feedback

18. What potential benefits, challenges, or unintended consequences do you foresee with developing and using consequential accounting methods for electricity-sector actions? Please include any practical considerations (e.g., feasibility, data needs, costs, comparability, clarity of claims).

6 Formula for quantifying emissions impacts from electricity projects

This section introduces equations used to quantify consequential emissions impacts from electricity procurement, as a first step toward an emissions impact methodology. It briefly summarizes formulas in existing GHG Protocol guidance and presents the Scope 2 TWG subgroup’s proposed equation, then seeks feedback on its structure (e.g., primary vs. secondary effects, reporting period).

In the GHG Protocol *Guidelines for Quantifying GHG Reductions from Grid-Connected Electricity Projects*, emissions impacts from electricity projects are quantified using the following set of formulas:

$$GHG\ Reduction_t = Primary\ Effect_t + \sum_s Secondary\ Effect_{s,t}$$

Where:

t = time period

s = secondary effect

$$Primary\ Effect_t = Baseline\ Emissions_{p,t} - Project\ Activity\ Emissions_{p,t}$$

$$Secondary\ Effect_t = Baseline\ Emissions_{s,t} - Project\ Activity\ Emissions_{s,t}$$

Finally:

$$Baseline\ Emissions_t = Emission\ Rate_{baseline,t} \times Generation_{project,t}$$

$$Project\ Activity\ Emissions_t = Emission\ Rate_{project,t} \times Generation_{project,t}$$

In plain language, this approach compares emissions in a baseline scenario, using marginal emission rates, to the emissions in the project scenario, using the specific emission rate of the project. For renewable energy generation the project scenario Primary Effect emissions are usually zero, meaning the emissions impact of the project is found by multiplying the emission rate by the quantity of generation from the project.

These emissions are summed for the expected lifetime of the project, to arrive at an estimation of the total emissions impact of the project.

6.1 Scope 2 TWG subgroup approach

To capture the emissions impacts of electricity projects, the Scope 2 TWG subgroup developed the following formula, which uses electricity consumption and marginal emission rates:

$$\text{Emissions Impact}_t = \sum_{i \in P_y} (\text{MWh}_i \times \text{MER}_i)$$

P_y = set of all procurement transactions in the reporting year

MWh_i = megawatt hours procured in transaction i

MER_i = marginal emission rate applicable to the grid region, time, and conditions of transaction i

Stated as a formula using hourly procurement and marginal emission rates:

$$\text{Emissions Impact}_i = \sum_{t=1}^{8760} (\text{MWh}_t^{\text{procured}} \times \text{MER}_t)$$

t = hour of the year

$\text{MWh}_t^{\text{procured}}$ = electricity procured during hour t

MER_t = marginal emission rate for the relevant grid/zone in hour t

Both approaches stated here utilize marginal emission rates multiplied by a volume of electricity project generation to arrive at an estimation of emissions impacts. While the *Guidelines* approach recommends summing impacts for the lifetime of the project, the Scope 2 TWG subgroup approach recommends limiting the analysis to the reporting year period only and suggests reporting these impacts each year.

The *Guidelines* approach also suggests including an analysis of secondary effects, such as fuel supply chain impacts or project development emissions, but notes that in many cases these impacts are small enough that they may be excluded. From the Guidelines on analysis of secondary effects:

"One-time effects are secondary effects related to GHG emissions that occur during the construction, installation, and establishment, or the decommissioning and termination of a project activity. Most grid-connected project activities involving the installation of power generation technologies will produce GHG emissions associated with construction and decommissioning. However, if a project activity displaces construction of another power plant – in other words, if it affects the build margin – then similar GHG emissions would also occur in the baseline scenario. Thus, in many cases one-time effects will not be significant, because one-time emissions will be roughly the same for both the project activity and the power capacity it displaces. One-time effects may be significant, however, for project activities that largely affect the operating margin.

Upstream and downstream effects are recurring secondary effects associated with the operating phase of a project activity. For grid-connected project activities these could include many things, including changes in GHG emissions associated with upstream extraction and transportation of fuels, or with downstream electricity consumption patterns. It is not necessary to conduct a full life-cycle analysis of a project activity's net impacts on GHG emissions. However, any changes in GHG emissions from upstream and downstream GHG sources should be considered if they are potentially significant.

Most grid-connected project activities will either reduce or cause no increase in fuel extraction and transportation GHG emissions, so changes in these emissions can often be ignored as secondary effects. Possible exceptions include project activities that use biofuels, where GHG emissions from fuel extraction, refining, and transportation could be significantly higher for the project activity than for the baseline scenario.

The significance of secondary effects will depend on their magnitude relative to the project activity's primary effect. Secondary effects may be excluded from the GHG assessment boundary if they involve a reduction, not an increase, in GHG emissions (e.g., a reduction in fuel extraction and transportation

emissions). Otherwise, if their magnitude is more than a few percent of the expected primary effect GHG reductions, they should be included in the GHG assessment boundary.”

The approach developed by the Scope 2 TWG subgroup does not consider secondary effects of electricity projects and focuses quantification entirely on the primary effects related to changes on the grid within a given reporting year.

6.2 Questions for public consultation

19. Is the proposed Scope 2 TWG subgroup formula appropriate for quantifying emissions impacts from electricity projects? (Please refer to the structure of the formula itself, and save comments on methodological details, such as marginal emission rates or eligibility requirements, for following sections of the survey.)
 - a. Yes
 - b. No
20. Please explain your answer to question 19.
21. Should the quantification of emissions impacts from electricity projects consider secondary effects in addition to primary effects?
 - a. Yes
 - b. No
22. If you answered “yes” to question 21, please provide additional context for what kinds of secondary effects should be considered, and how these may be quantified.
23. If you answered “no” to question 21, please provide additional context for why secondary effects should not be considered.
24. Should the emissions impacts of electricity projects be calculated and reported each reporting year, or should the emissions impacts for the entire lifetime of a project be reported once at the outset of the project?
 - a. Reported each year
 - b. Reported once for the lifetime of the project
25. Please explain your answer to question 24.

7 Treatment of additionality

This section introduces approaches for assessing additionality, the principle that claimed emission reductions or avoided emissions must result from actions that would not have occurred otherwise. It summarizes common tests used in existing programs and seeks feedback on which approaches are most appropriate, feasible, and rigorous for future GHG Protocol guidance. This input will help the AMI TWG refine additionality criteria as part of its continued work on consequential emissions impact accounting, consistent with ISB direction.

7.1 Background on additionality

Claims that actions have resulted in emission reductions or avoided emissions require demonstration that the reductions or avoidance would not have occurred absent the action, or absent funding provided by the purchase

of instruments. This concept is known as additionality, and various additionality tests have been in use in a variety of applications.

Common forms of additionality tests include, but are not limited to:

Regulatory test. This test checks whether a project is mandated by law or regulation. If the activity is already required by policy (for example, a utility standard or emissions cap), then implementing it cannot be claimed as additional. It ensures that credits or claims only support actions that go beyond legal baselines.

Timing test. This test focuses on whether the incentive (such as credits, PPAs, or certificates) influenced the decision to build or operate the project. If the project was already planned or under construction before the incentive was available, then it fails this test. The goal is to demonstrate that the mechanism played a decisive role in project initiation.

Financial analysis test. This test compares the project's expected return (e.g., IRR, NPV, payback period) against a threshold level of financial attractiveness. If the project would not have been pursued without the additional revenue stream, it passes the test. In practice, this often involves proving that the incentive shifted the project from financially unattractive to viable.

Barrier test. This test requires demonstration that significant barriers, such as technological, institutional, or market, would have prevented the project from moving forward. Examples include lack of financing, limited access to technology, or unfavorable policy environments. The additionality claim rests on showing that the incentive directly helped overcome these barriers.

Common practice test. This test benchmarks the project against others in the same region and sector. If similar projects are already widely implemented without incentives, then the project is considered "business as usual" and not additional. The idea is to avoid crediting actions that have become mainstream.

Positive list. A positive list is a predefined set of project types or circumstances that are automatically considered additional. For example, early-stage technologies, off-grid renewables, or projects in high carbon intensity regions may be included. This simplifies assessments and reduces transaction costs but can be overly broad if not updated regularly.

Performance standard test. This method sets a quantitative benchmark (e.g., a baseline emissions rate, energy efficiency level, or renewable penetration level) and considers any project that outperforms it as additional. It avoids case-by-case financial analysis by applying a uniform rule. The challenges lie in setting standards that are stringent enough to ensure real impact but flexible enough to allow participation, and in updating these performance standards regularly.

Contractual/tenor test. This test uses the nature of project contracts, particularly their duration, as an indicator of additionality. For instance, long-term PPAs can demonstrate that buyers provided the financial certainty needed for project financing. The idea is that without such commitments, projects would not have been built or financed.

First-of-its-kind test. This test is similar to the common practice test, and grants additionality to projects that introduce a new technology, scale, or application not yet present in a market or region. The assumption is that being the first to deploy something involves risks and barriers that would not be overcome without added support. Once the technology becomes established and replicated, subsequent projects no longer qualify.

Application of these additionality tests by programs usually includes combinations of multiple tests to form additionality frameworks. For example, a program might combine a regulatory test with a timing test and a common practice test, requiring projects to pass all three to be considered additional. Programs may also outline multiple pathways of tests, for example requiring either a financial analysis or a contractual test, to allow for some flexibility in how projects demonstrate additionality.

As described in GHG Protocol's *Project Protocol*, the choice of additionality tests and the stringency of these tests is an important consideration for programs.

"Whatever methods are used to address additionality, a GHG program must decide how stringent to make its additionality rules and criteria based on its policy objectives. Under the project-specific approach, stringency is determined by the weight of evidence required to identify a particular baseline scenario (and possibly to pass any required additionality tests—see Box 3.1). Under the performance

standard approach, stringency is determined by how low the performance standard GHG emission rate is relative to the average GHG emission rate of similar practices or technologies.

Setting the stringency of additionality rules involves a balancing act. Additionality criteria that are too lenient and grant recognition for "non-additional" GHG reductions will undermine the GHG program's effectiveness. On the other hand, making the criteria for additionality too stringent could unnecessarily limit the number of recognized GHG reductions, in some cases excluding project activities that are truly additional and highly desirable. In practice, no approach to additionality can completely avoid these kinds of errors. Generally, reducing one type of error will result in an increase of the other.

Ultimately, there is no technically correct level of stringency for additionality rules. GHG programs may decide based on their policy objectives that it is better to avoid one type of error than the other. For example, a focus on environmental integrity may necessitate stringent additionality rules. On the other hand, GHG programs that are initially concerned with maximizing participation and ensuring a vibrant market for GHG reduction credits may try to reduce "false negatives"—i.e., rejecting project activities that are additional—by using only moderately stringent rules."

The following chart shows how some existing additionality frameworks combine additionality tests. The list of frameworks is not exhaustive and is rather included to demonstrate examples of approaches across different applications of additionality. Frameworks include offset programs (UNFCCC, Verra), electricity-specific programs (US DOE 45V, RE100, Ever.Green), and general accounting frameworks (TCAT).

| Test | <u>UNFCCC CDM</u> | <u>Verra</u> | <u>TCAT</u> | <u>US DOE 45V</u> | <u>RE100</u> | <u>Ever.Green</u> |
|-----------------------------|-----------------------|--------------|-------------|-----------------------|--------------|-------------------|
| Regulatory | Required | Required | Required | Required | No | Required |
| Timing | Required | No | Required | Required | Required | Required |
| Financial analysis | Option | Option | Option | No | No | Required |
| Barrier | Option | Option | Option | No | No | No |
| Common practice | Required | Required | Option | No | No | No |
| Positive list | Partial | No | No | No | Required | No |
| Performance standard | Partial | No | No | No | No | No |
| Contractual | No | No | No | No | No | Partial |
| First-of-its-kind | Partial | No | No | No | No | No |

7.2 Questions for public consultation

26. For each of the provided additionality tests, indicate which tests should be included (required or optional) in a framework designed to assess additionality for renewable energy projects? For these questions, "required" indicates a mandatory test, such that all projects must pass the test in question to be eligible. "Optional" indicates that a test can be used to demonstrate additionality but is not mandatory. For optional tests, projects have the choice for which tests they use to demonstrate additionality.

- a. Regulatory test
 - i. Required
 - ii. Optional
 - iii. Not required

- b. Timing test
 - i. Required
 - ii. Optional
 - iii. Not required
- c. Financial analysis test
 - i. Required
 - ii. Optional
 - iii. Not required
- d. Barrier test
 - i. Required
 - ii. Optional
 - iii. Not required
- e. Common practice test
 - i. Required
 - ii. Optional
 - iii. Not required
- f. Positive list
 - i. Required
 - ii. Optional
 - iii. Not required
- g. Performance standard
 - i. Required
 - ii. Optional
 - iii. Not required
- h. Contractual/tenor test
 - i. Required
 - ii. Optional
 - iii. Not required
- i. First-of-its-kind test
 - i. Required
 - ii. Optional
 - iii. Not required

27. For the additionality tests you selected as required or optional, please provide commentary detailing why each should be included.

28. For each of the provided additionality tests, please indicate which tests are feasible to implement:

- a. Regulatory test
- b. Timing test
- c. Financial analysis test
- d. Barrier test
- e. Common practice test
- f. Positive list
- g. Performance standard
- h. Contractual/tenor test
- i. First-of-its-kind test
- j. None (no tests are feasible)

29. Please provide additional context or information on which tests are or are not feasible to implement.

30. Please list any additionality tests not already included here that should be considered as part of an additionality framework for renewable energy projects. Please explain why each test should be considered.
31. Should regional differences be considered in additionality tests (e.g. different combinations of additionality tests would be relevant or appropriate for different regions)?
- Yes
 - No
 - Unsure, depends on details
32. If you answered “yes” to question 31, please explain your answer, referencing specific examples of regions that warrant different kinds of tests.
33. Should the level of rigor in additionality tests be applied differently depending on the type of claim an organization wants to make? (e.g. association vs. causal claim).
- Yes
 - No
34. If you answered “yes” to question 33, please explain, citing the kinds of claims organizations should be able to make given different approaches to additionality tests.

8 Marginal Emission Rates

This section introduces approaches for determining marginal emission rates, the emission factors that represent how changes in electricity generation or consumption affect grid emissions. It outlines existing methodologies for both operating margin and build margin calculations and requests feedback on which approaches are most appropriate, credible, and feasible to use in avoided-emissions accounting. This input will inform the AMI TWG’s continued development of consistent, sector-agnostic methods in line with ISB direction.

Emission factors that capture the emission rates of marginal electricity generators are referred to as marginal emission rates. These rates can be calculated ex post, using historical grid dispatch data, or ex ante, based on estimated grid deployment. These rates can be calculated with relatively granular geographic boundaries, and at an hourly or sub-hourly temporal granularity.

Two types of marginal emission rates exist, that capture either operational or structural grid impacts:

- **Operating margin emission rates.** Operational grid impacts are the immediate impacts that occur based on an increase or decrease in demand on the grid. Operating margin emission rates consider the emission rates of the marginal generator(s) only, also known as the operating margin, and are therefore best suited to estimate impacts from discrete, temporary, and small changes in demand and generation.
- **Build margin emission rates.** Structural grid impacts are the longer-term impacts associated with grid evolution over time and consider the emission rates of the mix of generating resources that are likely to be built to meet increased energy demand or retired to meet reductions in demand. Structural grid impacts, also known as build margin impacts, are useful in estimating impacts from permanent and large changes in demand and generation, as well as policy changes.

8.1 Existing methodologies for quantifying operating margin emission rates

Existing methodologies for operating margin emission rates (OMERs) include the following categories of approaches:

- **SCED sensitivity analysis** – Grid operators dispatch units in their market using a “security-constrained economic dispatch” (SCED) optimization model that accounts for generator economics,

transmission constraints, and grid reliability needs. One byproduct of these models are sensitivity factors and other data that can be used to infer the identity of marginal units, and how each marginal unit would be re-dispatched in response to an intervention anywhere on the grid. This approach may leverage data directly from grid operators or from third-party simulations/estimates. These SCED byproducts can be used to produce two different types of operating margin data:

- **Fuel-on-the-margin** – this approach uses information about the fuel type(s) of the inferred marginal unit(s) to estimate a marginal emission rate, generally for the entire market footprint.
- **Locational** – this approach uses information about the inferred marginal unit re-dispatch to estimate marginal emission rates for each node of the grid.
- **Scenario modelling** – Scenario modelling approaches also leverage SCED models, but rather than extrapolating from the byproducts of a single SCED solution, this approach models both a baseline scenario and a scenario with an intervention, and determines marginal emission rates by comparing the differences in the outputs between the two scenarios.
- **Heat-rate/LMP** – This approach estimates marginal emission rates from locational marginal price (LMP) data, using the assumption that the LMP reflects the variable operating cost (i.e. fuel cost) of the marginal unit. In combination with fuel cost data, this can be used to infer the heat rate of the marginal unit, which, in combination with assumptions about the fuel type of the marginal unit, can be used to estimate emissions.
- **Statistical** – Statistical models use empirical data to estimate the causal response expected from an intervention conditioned on known information (e.g., time of day, level of demand, LMP, weather) to determine the marginal emissions rate.
- **Capacity factor based** – This approach identifies which units are most likely to be “load following” (and thus marginal), using information about the capacity factor of the generator (i.e., what percent of the total capacity does it use). Generators with a high-capacity factor are more likely to represent “baseload” generation that is always on and does not respond to changes in the grid, while generators with low-capacity factors are more likely to follow load. The marginal emission rate is the weighted average rate of these load following generators.
- **Difference-based** – This approach calculates the change in system emissions from one time to the next and divides it by the change in system load over the same timestep.

The following table indicates many OMER datasets used and categorizes them based on methodological approach:

| OMER Dataset | Category | Coverage | Spatial Granularity | Temporal Granularity |
|------------------------------|---------------------------|------------|---------------------|----------------------|
| PJM | SCED (locational) | PJM | Nodal | 5 minute |
| MISO | SCED (fuel-on-the-margin) | MISO | Entire ISO | 5 minute |
| SGIP Signal | Heat-rate/LMP | California | Zonal | 5 minute |
| REsurety | SCED (locational) | U.S. | Nodal | Hourly |
| Singularity | SCED (fuel-on-the-margin) | U.S. | Entire ISO | Sub-hourly |
| WattTime | Statistical | Global | Zonal | 5 minute |
| EPA AVERT | Statistical | U.S. | Grid region | Hourly |
| EPA eGrid | Capacity factor based | U.S. | Grid region | Annual |
| NREL Cambium | Scenario modeling | U.S. | Grid region | Hourly |
| NYISO | Heat-rate/LMP | NYISO | Zonal | 5 minute |
| IGES | Various | Global | Country | Annual |
| IFI | Heat-rate/LMP | Global | Country | Annual |
| IEA | Difference-based | Global | Country | Hourly |

8.2 Existing methodologies for quantifying build margin emission rates

Existing methodologies for build margin emission rates (BMERs) include the following categories of approaches:

- **Recent capacity additions** – Uses empirical data about the most recent generator capacity added to a grid and calculates a weighted average emission rate of these units, assuming that future build out will have similar emission rates to what was recently added to the grid.
- **Policy scenario** – Projects modeled future new build information from IEA’s Stated Policies Scenario, which is based on a combination of existing and planned country level policies.
- **Capacity expansion modeling** – These grid models simulate buildout and retirement of generation based on different scenarios. Build margin rates can be estimated based on the capacity that is added to or removed in the model results.
- **Average emission factor** – Uses a “location-based method” style average of existing grid generation to estimate the emission rate of units that would be built or retired.

The following table indicates known BMER datasets and categorizes them based on methodological approach:

| BMER Dataset | Category | Coverage | Spatial Granularity | Temporal Granularity |
|--------------------------------|------------------------------|----------|---------------------|----------------------|
| Climate TRACE | Recent capacity additions | Global | Zonal | Hourly |
| NREL Cambium | Capacity expansion modeling | U.S. | Grid regions | Hourly |
| IGES | Recent capacity additions | Global | Country | Annual |
| IFI | Policy scenario | Global | Country | Annual |
| UK Government | Capacity expansion modelling | UK | Country | Annual |
| Average emission factor | Average emission factor | Global | Various | Various |

8.3 Questions for public consultation

35. Which methodology or methodologies **are appropriate** for quantifying the operating margin emissions impacts of renewable energy projects? (select all that apply).
- SCED – fuel on the margin
 - SCED – locational
 - Scenario modeling
 - Heat-rate/LMP
 - Statistical
 - Capacity factor based
 - Difference-based
 - None
36. Which methodology or methodologies for quantifying the operating margin emissions impacts of renewable energy projects **are not appropriate**? (select all that apply).
- SCED – fuel on the margin
 - SCED – locational
 - Scenario modeling
 - Heat-rate/LMP
 - Statistical

- f. Capacity factor based
 - g. Difference-based
 - h. None
37. Please provide any additional explanations or further details regarding which operating margin methodologies are or are not appropriate.
38. Which methodology or methodologies **are appropriate** for quantifying the build margin emissions impacts of renewable energy projects? (select all that apply).
- a. Recent capacity additions
 - b. Policy scenario
 - c. Capacity expansion modelling
 - d. Average emission rate
 - e. None
39. Which methodology or methodologies for quantifying the build margin emissions impacts of renewable energy projects **are not appropriate**? (select all that apply).
- a. Recent capacity additions
 - b. Policy scenario
 - c. Capacity expansion modelling
 - d. Average emission rate
 - e. None
40. Please provide any additional explanations or further details regarding which build margin methodologies are or are not appropriate.
41. How could GHG Protocol assess these models' applicability to different types of projects? Factors that could affect applicability may include, but are not limited to, project size, shape, and capacity factor.
42. What other types of emission rates or metrics may be appropriate for assessing the emissions impacts of projects?
43. What is the maximum appropriate level of spatial granularity for marginal emission rates?
- a. Country
 - b. Grid region
 - c. Balancing area
 - d. Zonal
 - e. Nodal
44. Please provide context regarding your answer to question 43.
45. What is the maximum appropriate level of temporal granularity for marginal emission rates?
- a. Annual
 - b. Monthly
 - c. Daily
 - d. Hourly

e. Sub-hourly

46. Please provide context regarding your answer to question 45.

9 Build and operating margin weighting

This section addresses how to balance or weight operating margin and build margin impacts when estimating the emissions effects of electricity projects. It summarizes existing approaches used in GHG Protocol and other programs, as well as additional concepts raised by the Scope 2 TWG subgroup and seeks feedback on which weighting methods are most appropriate and practical. Responses will guide the AMI TWG in developing consistent approaches for combining short-term and long-term grid impacts in future avoided-emissions methodologies, consistent with ISB direction.

Approaches to estimating the emissions impacts of projects require considering both immediate and long-term changes. A discrete change in supply or demand on the grid may initially only impact the operating margin, but over time these changes will result in structural changes on the grid, and therefore also impact the build margin. For example, an organization that installs an onsite solar array may initially cause decreased output from a nearby combined-cycle gas generator (operating margin impact of roughly ~800 lb CO₂/MWh), but over time this persistent reduction in net load can affect long-term capacity planning and retirements, and may result in retirement of a coal generator (build margin impact of roughly ~2,000 lb CO₂/MWh). In this scenario the operating margin impact is significantly different than the build margin impact, so careful consideration and weighting of each is essential.

As described in the [Guidelines]:

"Grid-connected project activities can affect the build margin, the operating margin, or both. A critical step in estimating baseline emissions involves assigning appropriate weights to both of these possible effects."

9.1 Calculating build and operating margin weights

Several resources provide guidance on applying appropriate weights to build and operating margin emission rates. Some resources refer to the combination of build and operating margin emission rates as the "combined margin" or CM.

Guidelines for Quantifying GHG Reductions from Grid-connected Electricity Projects

- Asks a series of questions to determine whether there is significant generating capacity on the grid, or chronic under-capacity, and suggests a build margin weight of 0 or 1 respectively in these cases.
- Asks whether the project provides firm power, if it does, suggests a build margin weight of 1.
- If the project does not provide firm power, suggests a formula for determining build margin weight, inclusive of three variables: capacity value, rated capacity, and capacity factor.

Build margin weight = the lesser of 1, or (Capacity Value / (Rated Capacity x Capacity Factor))

In cases where determining a precise capacity value or capacity factor is not possible, the following defaults are suggested for the build margin weight:

- Project provides firm power, and on-peak, baseload, or intermittent generation: 1
- Project provides firm power, and exclusively off-peak generation: 0.5
- Project does not provide firm power, and on-peak, baseload, or intermittent generation: 0.5
- Project does not provide firm power, and exclusively off-peak generation: 0

[UNFCCC CDM Tool to calculate the emission factor for an electricity system](#)

Default approach:

- Wind and solar generating facilities are given a default build margin weight of 0.25.
- All other projects are given a build margin weight of 0.5 for the first crediting period (7 to 10 years), and 0.75 for the second and third crediting periods.

UNFCCC acknowledges that other weighting approaches are possible, and while it does not suggest alternative formulas for calculating weights, it suggests several factors that may influence how to derive these weights:

| Factor | Summary | Further Explanation |
|----------------------------------|---|--|
| Project size | No change in weight on basis of absolute or relative size alone. | Alternative weights on the basis of absolute or relative project size alone do not appear to be justified. |
| Timing of project output | Can increase OM weight for highly off-peak projects; increase BM for highly on-peak projects. | Projects with mainly off-peak output can have a greater OM weight (e.g. solar PV projects in evening peak regions, seasonal biomass generation during off-peak seasons), whereas projects with disproportionately high output during on-peak periods (e.g. air conditioning efficiency projects in some grids) can have greater BM weight. |
| Predictability of project output | Can increase OM for intermittent resources in some contexts. | Projects with output of an intermittent nature (e.g. wind or solar projects) may have limited capacity value, depending on the nature of the (wind/solar) resource and the grid in question, and to the extent that a project's capacity value is lower than that of a typical grid resource its BM weight can be reduced. Potential adjustments to the OM/BM margin should take into account available methods (in technical literature) for estimating capacity value. |
| Suppressed demand | Can increase BM weight for the 1st crediting period. | Under conditions of suppressed demand that are expected to persist through over half of the first crediting period across a significant number of hours per year, available power plants are likely to be operated fully regardless of the CDM project, and thus the OM weight can be reduced. |

Other approaches

Additional approaches to assigning weights to build and operating margin emission rates were suggested by members of the Scope 2 TWG subgroup. These approaches, while not formalized in existing programs or standards, may constitute relevant considerations.

- **Default 0.50 build margin weight for all projects.** This approach was suggested as a feasible and consistent method of determining weights.
- **Resource adequacy approaches.** These approaches use metrics like net qualifying capacity or effective load carrying capacity to assign values to the ability of a project to meet grid needs during peak load hours. These metrics could serve as effective build margin weights for projects.
- **Intervention lifecycle approaches.** These approaches consider the extent to which a project has been considered in formalized grid planning processes. If a project has not been anticipated in capacity planning, operating margin rates alone may be used for the first 5 years of a project, after which build margin rates should be used. If a project has been considered in capacity planning, build margin rates alone may be used at the project outset.

9.2 Questions for public consultation

47. Which, if any, of the included approaches for assigning build and operating margin weights for electricity projects are appropriate? (select all that apply)

- a. GHG Protocol Guidelines for Quantifying GHG Reductions from Grid-connected Electricity Projects
 - b. UNFCCC CDM Tool07
 - c. Default 0.50 build margin weight for all projects
 - d. Resource adequacy approaches
 - e. Intervention lifecycle approaches
 - f. None are appropriate
 - g. Unsure
48. If you selected any of these approaches, please explain why the approach is appropriate for assigning build and operating margin weights for electricity projects.
49. Which, if any, of the included approaches for assigning build and operating margin weights for electricity projects are not feasible to implement? (select all that apply)
- a. GHG Protocol Guidelines for Quantifying GHG Reductions from Grid-connected Electricity Projects
 - b. UNFCCC CDM Tool07
 - c. Default 0.50 build margin weight for all projects
 - d. Resource adequacy approaches
 - e. Intervention lifecycle approaches
 - f. All are feasible
 - g. Unsure
50. If you selected any of these approaches, please explain why the approach is not feasible to implement.
51. Other than the approaches listed here, what approach could be used to assign build and operating margin weights for electricity projects?
52. Please provide any research or documentation to support your suggested approach.

10 Thank you

GHG Protocol would like to thank you for your participation in this consultation and in particular for taking the time to submit feedback. This is a critical step in our process and will help strengthen the standards in development to ensure they are credible, reliable and fit-for-purpose.