# Global Heat Reduction Registry Standard

Version 2.0
August 2025

GLOBAL HEAT REDUCTION™

**Global Heat Reduction Registry Standard**

**Published October 2024 – Version 1.1**

**Revised August 2025 – Version 2.0**

# Table of Contents

# FOREWORD

The Global Heat Reduction (GHR) Initiative was launched to introduce a new comprehensive climate accounting approach, complementing current climate accounting systems. It is a direct application of the consensus science summarized in the Intergovernmental Panel on Climate Change (IPCC) synthesis and special reports of the past decade, especially the reports from the Working Group 1 in the Fifth and Sixth Assessments (AR5 and AR6), and in Global Warming of 1.5°C. This science, peer reviewed by the Scientific Advisory Panel of the international Climate and Clean Air Coalition, a United Nations convened organization, points to a broad range of climate change drivers, some of which are widely recognized, while others are only recently gaining serious attention among corporate sustainability managers, policy makers, and climate finance circles.

Among its programs, GHR has established the Global Heat Reduction Registry to register and facilitate transactions for high-quality credits, reported in $tCO_2e$ units as well as in corresponding units of $tCO_2fe$ reflecting the associated reduction in radiative forcing. The Registry addresses the full range of climate forcers, including greenhouse gases (GHGs) and other short-lived climate pollutants as well as non-emission forcers that contribute to climate change. Additionally, it addresses project co-benefits to human health and the environment, including many indicators aligned with the United Nations Sustainable Development Goals framework, as well as human health and environmental trade-offs, to provide greater transparency and support more informed decision-making about projects.

This Registry Standard provides general guidance for program participation. Specific considerations by project type are addressed in approved methodologies.

**Key Resources**

- ***Global Heat Reduction Glossary of Terms:*** A compilation of terms and definitions related to the Initiative and all of its projects, including the Registry.
- ***Registration Platform:*** A digital platform that serves as the central repository for data pertaining to all registered projects, and as a tracking system for the generation, transfer, retirement, and cancellation of all verified credits.
- ***Registry Standard:*** The Standard describes the general program rules and requirements that all projects must follow to be registered.
- ***Methodologies:*** Specific rules and data required to assess projects in selected categories, consistent with the Registry Standard.

For more information about these and other resources, see www.heatreduction.com.

# 1. INTRODUCTION

### 1.1. Purpose

The purpose of this Standard is to establish general requirements related to the Global Heat Reduction Registry (the "Registry"), including the development of climate mitigation projects, validation and verification of positive radiative forcing (RF) reduction (i.e., heat reduction), co-benefits and trade-offs associated with such projects, project registration, and issuance of credits.

### 1.2. Intended Users

This Standard is intended for use by entities that develop and implement projects aimed at reducing the climate impacts of their project, third-party validation and verification bodies (VVBs) assessing conformance to Standard criteria, and entities interested in purchasing credits for investment, offset, or other purposes.

### 1.3. Version

This Standard is periodically updated. It is the responsibility of the document reader to ensure use of the most current version of the document. This is Version 2.0.

### 1.4. Terms

Definitions of program terms, definitions, abbreviations, and acronyms used in this Standard are defined in the *Global Heat Reduction Glossary of Terms*.

### 1.5. Language

The Registry uses English as the operating language. All program-related procedures, descriptions, reports, and other documentation are in English. Word spellings are American English, unless referring to specific organizations or documents.

### 1.6. Word Usage

The verbs "shall" and "must" are used in criteria to indicate a requirement of the Standard. The verbs "can" and "may" are used to express permission to perform an action that is not a requirement.

### 1.7. Revisions Schedule

Revisions to the Standard will occur at minimum every three years, with any required updates such as changes to accounting, changes in best practice climate forcer accounting, or regulatory updates, as needed. Each successive version of the Standard will be available for public comment for at least 30 days prior to adoption. All comments received during this time will be responded to by the Registry, and comments will be posted with the new version of the Standard including issue resolution.

## 2. PROJECT ELIGIBILITY AND SCOPE OF ASSESSMENT

*Projects shall conform to the Registry program's framework, align with its goals of being comprehensive, global, and scientifically robust, and reinforce UN Sustainable Development Goals.*

### 2.1. Project Eligibility

**2.1.1.** A project shall be deemed eligible for participation in the Registry program if:

a. it is a Registry-recognized project type with an approved Methodology;
b. proof of legal ownership of the project at the designated site(s) is demonstrated (see Section 5.2);
c. it is an actual project, with a defined start date (i.e., the date on which project activities began to reduce RF) per the approved Methodology;
d. it is additional (see Section 5.5);
e. it is permanent (see Section 4.4);
f. it is consistent with the minimum project term and crediting period; and
g. it is in compliance with applicable regulations.

**2.1.2.** A project shall be deemed eligible to be issued credits and to be listed on the Registry if:

a. It meets the requirements of this Standard and the applicable Methodology,
b. It is validated and verified by one or more approved VVBs in accordance with the requirements of the *Validation and Verification Manual* and this Standard;
c. Sufficient procedures have been established to monitor progress, either positive or negative, toward meeting the heat (i.e., positive RF) reduction goals of the project.

### 2.2. Project Types

**2.2.1.** The Registry primarily focuses on project types that have a high impact on near-term reductions in positive radiative forcing. New project types shall be considered for Methodology development and recognition under the Registry pending an assessment of:

a. availability of technology required;
b. regulatory landscape;
c. precedent for assessment within the voluntary carbon market;
d. access to essential infrastructure;
e. level of necessary funding;
f. potential environmental or human health co-benefits or trade-offs; and
g. scientific understanding of the relevant processes.

GHR will consider new projects from across the globe and is not limited geographically.

**2.2.2.** The following project types shall be excluded from consideration:

a. Projects that convert or clear undisturbed native ecosystems;
b. Projects that quantify GHG emission reductions from electricity generation connected to a national or regional power distribution grid;
c. Projects that result in long-term positive RF equaling or exceeding the baseline scenario case;
d. Forestry-based projects (e.g. REDD+ projects)

e. Reductions or removals achieved by a mitigation activity where the units related to the same climate impacts of the mitigation activity are traded in other environmental markets or accounting frameworks (Renewable Energy Certificates, for example)
f. Projects that force physical or economic displacement.

The Registry shall retain the right to reject any project type for these or other reasons.

**2.2.3.** Methodologies shall be established to provide the criteria and procedures for quantifying reductions in positive RF, as well as determining co-benefits and trade-offs, by specific project types. A Methodology for a given project type shall be developed and approved by the Registry before a project of that type can be assessed and issued credits.

**2.2.4.** A Methodology can be developed either by the Registry, or by a third party as described in the GHR *Methodology Development and Approval Process* document. The Methodology shall define the boundary conditions and methods to be used in assessing, validating, and verifying any project falling under that category, and includes, at a minimum:

a. Function of projects within the Project type;
b. Permissible technology(ies) utilized by projects within the Project type;
c. System boundaries for projects within the category, including spatial/geographic and temporal conditions;
d. Sources of RF, positive and negative, RF sinks, and reservoirs;
e. Impact categories in which co-benefits or trade-offs may occur;
f. SDG targets that may be affected by a given project;
g. Data and monitoring required for projects;
h. Preferred data sources;
i. Calculation methods;
j. Reporting parameters for projects.

***NOTE:*** *See also the Methodology Template. Methodologies developed by third parties must go through the SCS-controlled review process, including review by SCS, an independent expert panel, and public consultation.*

***NOTE:*** *RF sources, sinks and reservoirs (RF SSRs) include but are not limited to GHG SSRs.*

### 2.3. Climate Forcers

**2.3.1.** All climate forcers associated with a project that can be estimated or measured shall be included in the Methodology. Per the template requirements, estimated or measured climate forcer results shall be reported in the associated Project Design Document, Monitoring Report, Validation Report, and Verification Report, whether they result in positive or negative RF (Table 1).

**Table 1. Climate Forcers**

| *Climate Forcers Contributing to Positive RF* | *Climate Forcers Contributing to Negative RF* |
|---|---|
| **Well-mixed GHGs** | **Well-mixed GHGs** |
| Carbon dioxide ($CO_2$) | None |
| Methane ($CH_4$) | |
| Nitrous oxide ($N_2O$) | |
| **GHG categories that include both well-mixed and non-well-mixed climate forcer species** [1)] | **GHG categories that include both well-mixed and non-well-mixed climate forcer species** |

| | |
|---|---|
| Chlorofluorocarbons (CFCs) | None |
| Hydrochlorofluorocarbons (HCFCs) | |
| Hydrofluorocarbons (HFCs) | |
| Bromocarbons, Hydrobromocarbons and Halons | |
| Fully Fluorinated species | |
| Halogenated Alcohols, Ethers, Furans, Aldehydes and Ketones | |
| **Non-well-mixed climate forcers [2)]** | **Non-well-mixed climate forcers** |
| Black carbon | Nitrate aerosols |
| Brown carbon | Organic carbon |
| Tropospheric ozone (from non-methane precursor including NOx [3)], CO, and VOCs) | Sulfate aerosols |
| Miscellaneous Compounds [4)] | |
| **Non-emission climate forcer** | **Non-emission climate forcer** |
| Decrease in Albedo | Increase in Albedo |
| Waste Heat | |

*1) This grouping covers GHG categories that include both well-mixed and non-well-mixed species. A comprehensive list of GHGs and their atmospheric lifetimes can be found in IPCC AR6 WG1 "7.SM Chapter 7: The Earth's energy budget, climate feedbacks, 3 and climate sensitivity - Supplementary Material, Table 7.SM.7.* https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FGD_Chapter07_SM.pdf

*2) Neither mineral dust nor water vapor are currently included in the corporate analysis. Mineral dust is primarily a negative climate forcer, but can also cause warming, depending on the iron and aluminum content and the particle size. See Jacobson, M.Z., Global direct radiative forcing due to multicomponent anthropogenic and natural aerosols, J. Geophys. Res., 106, 1551-1568, 2001. Water vapor is a positive climate forcer, but is primarily associated with natural processes rather than anthropogenic sources.*

*3) Tropospheric ozone is a potent climate forcer, but the chemical pathway for its formation is complex. Some portion of ozone formation can be attributed to methane as a precursor, and is therefore included in methane accounting. The remaining anthropogenic ozone is formed by other precursors, and is referenced here. The RF attributable to an emission of NOx is highly variable depending upon region of emission and season of emission, and may also vary greatly year-to-year. Site-specific atmospheric modeling is required for accuracy, but is also generally impractical. Therefore, the accounting of the RF effects from NOx, while desirable, remains optional at this time.*

*4) A comprehensive list of miscellaneous compounds can be found in IPCC AR6 WG1 7.SM Chapter 7: Table 7.SM.7*

**2.3.2.** If a climate forcer described in 2.3.1 is required by a Methodology, and omitted by the Project Proponent, a justification shall be provided in the *Project Design Document*.

**2.3.3.** The accumulated GHGs shall be determined for each year of the project, starting from the date of project initiation.

***NOTE:*** *"Accumulated GHGs" refers to the fraction of residual well-mixed GHG emissions released at any time by the project that remains in the atmosphere at a subsequent point in time.*

**2.3.4.** The radiative efficiency of climate forcers shall be reviewed annually for consistency with the latest IPCC reports.

**2.3.5.** System boundaries for the assessment of climate forcers shall be consistent with the applicable Methodology, and sufficient to address:

a. RF from project-owned or controlled sources;
b. RF associated with material or energy flows into, out of, or within the project, whether onsite or off-site (e.g., from the generation of purchased electricity, steam, heating, and cooling);
c. RF from other sources during the project life cycle that are directly affected by the project; and
d. Project co-benefits, other SDGs as applicable, and trade-offs (see 2.4).

### 2.4. Co-benefits, Trade-offs, and SDGs

**2.4.1.** All known potential environmental and human health impact co-benefits (i.e., project impacts compared to the baseline scenario that are beneficial) and trade-offs (i.e., project impacts compared to the baseline scenario that are harmful) associated with a project type shall be stated for consideration in the Methodology as impact categories and shall be considered and addressed in the associated *Project Design Document* and *Project Monitoring Report* for projects implementing the Methodology.

Examples of possible impact categories that could be relevant to the project type are shown in Table 2. Only those categories relevant to the project type should be considered for a given Project.

a. Each Validation Report or Verification Report shall state how the relevant co-benefits and trade-offs were assessed.
b. To the extent that a verified project co-benefit coincides with an SDG indicator, this information shall be reported accordingly.

*NOTE: While climate change is associated with impacts such as temperature rise, warming oceans, thermal expansion of oceans, and heat impacts on ecosystems, co-benefits and trade-offs refer to those impacts to human health and the environment that are distinct from the climate change impacts.*

**Table 2. Examples of impact categories that could affect the environment or human health, depending on the type of project being assessed.**

| Impact Group | Impact Category |
|---|---|
| Resource Depletion | Non-Renewable Energy Resource Depletion |
| | Net Freshwater Consumption |
| | Critical Minerals Resource Depletion |
| | Biotic Resource Depletion |
| Ocean Ecosystem Impacts | Ocean Acidification |
| | Marine Biome Disturbance |
| | Marine Eutrophication |
| | Key Species Loss |
| | Persistent Ecotoxic Chemical Loading |
| | Marine Plastic Loading |
| Terrestrial Ecosystem Impacts (impacts from Emissions) | Regional Acidification |
| | Stratospheric Ozone Depletion |
| | Freshwater Ecotoxic Exposure Risks |
| | Freshwater Eutrophication |
| | Terrestrial Eutrophication |
| Terrestrial Ecosystem Impacts Group (impacts from Land Use and Land Conversion) | Terrestrial Disturbance |
| | Freshwater Disturbance |
| | Threatened Species Impacts |
| | Soil Degradation and Erosion |

| | |
|---|---|
| | Noise and Vibration |
| Human Health Impacts (from Chronic Exposures to Hazardous Substances) | Ground Level Ozone Exposure Impacts |
| | PM2.5 Exposure Impacts |
| | Hazardous Ambient Air Contaminant Exposure Impacts |
| | Hazardous Indoor Air Contaminant Exposure Impacts |
| | Hazardous Food and Water Contaminant Exposure Impacts[1] |
| | Hazardous Dermal Contaminant Impacts |
| Risks from Hazardous Wastes | Risks from Radioactive Wastes |
| | Residual Risks from Untreated Hazardous Wastes |

**2.4.2.** If one or more impact categories are not considered by a project, a justification shall be provided in the associated *Project Design Document* and *Monitoring Report*. Each *Validation Report or Verification Report* shall include the VVB's conclusions related to the exclusion of the co-benefits or trade-offs.

**2.4.3.** Projects with social, environmental, and socio-economic benefits that extend beyond the scope of the project's co-benefit/trade-off analysis within the context of this Standard and the Methodology, including benefits recognized under the UN SDGs, may choose to participate in other programs that quantify such attributes, subject to the following requirements:

a. Projects intended for simultaneous reporting of such attributes shall be subject to evaluation upon project listing and during validation of the Project Design Document, provided that the Project Proponent discloses to GHR the intent and details of the project prior to validation;
b. The project activity shall not be required by regulation to achieve the additional benefit; and
c. The project activity shall account for significant secondary effects (i.e., leakage) outside the project's geographic boundary that results in increased RF.

*NOTE: See further discussion of co-benefits and trade-offs in Section 5.9.*



[1] Including chemical pesticides and fertilizers

# 3. PRINCIPLES

*Projects shall be designed and assessed in conformance with defined principles to ensure that the heat reduction mitigation value (i.e., reduction in positive RF) is accurately and credibly calculated.*

### 3.1. General Principles

**3.1.1.** The Project Proponent, VVB, and Registry shall apply the following principles to the development and assessment of projects:

a. *Relevance:* RF-related information, data, and methodologies are applicable to the Project Proponent and the project scope of assessment. All relevant information that may affect the accounting and quantification of climate forcers and reductions in positive RF are included.
b. *Completeness:* Known information and data pertaining to RF sources and reduction, relevant information to demonstrate conformance to criteria, and information pertaining to procedures are included and shall be available at validation and verification.
c. *Consistency:* Information supports meaningful comparisons, and consistent methods are used. Project information present is consistent throughout project documents.
d. *Accuracy:* Bias and uncertainties are considered and minimized to the degree practical. Methodologies include methods for estimating uncertainty relevant to the baseline and project scenario. Project documents accurately reflect information about the project.
e. *Transparency:* Sufficient information is disclosed to support decisions by intended users with reasonable confidence. Information is provided for any relevant assumptions, and appropriate references are provided for accounting and calculation methods and for data sources used. Any changes to the data, boundary, methods, or any other relevant factors are documented.
f. *Conservativeness:* Conservative assumptions, values, and procedures are applied to avoid overstating a reduction, removal or co-benefit from the project. Methodology quantification methods are designed to ensure that RF reductions are not overestimated, particularly when estimation methods are relied upon in lieu of direct measurement. In terms of credit issuance, RF reduction claims shall be rounded down to the nearest whole number; and calculated buffer pool contributions shall be rounded up to the nearest whole number. Specific guidance on measurement conservativeness is available in each Methodology.
g. *Significance:* The inclusion of climate forcers in the quantification is justified based on their relative contribution to the total footprint.

***NOTE:*** *For Methodologies involving statistical sampling, the sampling error associated with the mean of the estimated RF reduction should not exceed ±10% of the mean at the 90% confidence interval. Project Proponents who cannot meet this target should report an amount equal to the mean minus the lower bound of the 90% confidence interval, applied to the final calculation of total RF reduction, unless the Methodology specifies an alternative approach. When modeling is used to estimate emissions and/or removals, estimates of input uncertainty and structural uncertainty related to the inadequacy of the model, model bias, and model discrepancy should be included.*

**3.1.2.** The Project Proponent shall establish and apply quality assurance and quality control (QA/QC) procedures to manage data and information, and include information about planned and implemented procedures in the *Project Design Document* and *Monitoring Report*, respectively.

**3.1.3.** The Project Proponent shall state any limitations encountered in the application of these principles during the project design phase in the *Project Design Document* and any applicable updates in the *Monitoring Report*.

# 4. CREDIT REQUIREMENTS

*Verified credits are available from projects to purchasers as credits for offset or investment purposes, or in support of climate stabilization targets on the GHR platform.*

### 4.1. Credit Issuance

**4.1.1.** Credits shall only be issued upon verification of the project's reductions in positive RF for the verified monitoring period.

**4.1.2.** Verified "heat reduction credits" (HRCs) shall be tagged by vintage year – i.e., the year in which the RF reduction is verified to have occurred. Credits may only be issued for actual reductions in positive RF achieved – as *ex-post* credits. No *ex-ante* credits shall be issued. The project proponent sets the price of the credits. GHR is the registry and not the project proponent.

**4.1.3.** Verified credits shall be issued in HRCs. Each unit equals one tonne of carbon dioxide equivalent (t $CO_2e$ based on GWP100). In addition, GHR Methodologies provide the tonnes of carbon dioxide forcing equivalents (t $CO_2fe$) for all credits, as well as the corresponding RF (heat) units in terajoules (TJ) and in watts per square meter ($W/m^2$) or a derivative (e.g., $nW/m^2$).

***NOTE:*** *$CO_2e$ values are calculated in most registries based on a global warming potential of one hundred years (GWP100). For GHGs, GWP100 values are based on the most current IPCC synthesis report, which is AR6 at the time of publication of this version. $CO_2fe$ values are calculated and reported for each year over the monitoring period and can be for selected target timeframes (e.g., to 2030, to 2050, 100 years) to highlight the global heat reduction over these different timeframes, based on the methods in Appendix A.*

**4.1.4.** Verified HRCs shall have a unique serial number and be registered.

**4.1.5.** No credits will be issued for projects that increase emissions of negative climate forcer pollutants (e.g., sulfate aerosol injection) resulting in negative RF (see Appendix A, Figure 1.b).

### 4.2. Monitoring Periods

**4.2.1.** Verification of the project's RF reductions shall occur over a monitoring period of 1 to 5 years from the project start date or last completed verification, as defined in the applicable Methodology (see Figure 1).

**4.2.2.** If a project fails to be verified for a given vintage year up to the beginning of the current monitoring period, the project shall be ineligible for further credits.

### 4.3. Minimum Project Term and Crediting Period

**4.3.1.** A minimum project term shall be established for any project that has a risk of reversal. The project term is the length of time that a project is obligated to remain active (i.e., continuation of monitoring, reporting, and verifying). The Project Proponent shall commit to a minimum project term as stipulated in the associated Methodology. If there is no identified risk of reversal stipulated in the associated Methodology, the Project Proponent does not need to establish a minimum project term.

**4.3.2.** The creditable lifetime of the project (i.e., the "crediting period,") shall be determined for each project type, consistent with the applicable Methodology. The crediting period shall not exceed 10 years, but the crediting period can be renewed if the project will continue to reduce positive RF in subsequent years, consistent with the applicable Methodology. Crediting periods including renewals shall not exceed 20 years.

Commented [JN1]: @Esther Soh this is where the updated graphic should be dropped in. Thanks!


**Figure 1. Relative timeframes associated with vintage years, monitoring periods, project crediting periods, and minimum project terms**

Any renewal of the crediting period shall include a reassessment of the baseline scenario, including reconfirmation that conditions and barriers at the start of the mitigation activity still prevail, and an update of relevant parameters used to calculate emissions reductions and removals. The applicable Methodology identifies the allowable number of years between verification events and additional procedures for calculation and verification. The applicable Methodology states the number of times a project can be renewed.

### 4.4. Permanence, Reversals, Secondary Effects, and Buffer Pools

**4.4.1.** The Project Proponent shall design projects with the goal of creating permanent reductions in positive RF, and shall identify risks that could jeopardize this permanence and cause future reversals in such reductions (see 5.3.1).

***NOTE**: The term, "permanence," widely used in carbon markets, is a relative term in that there is no scientific means of determining definitively how many years into the future a reduction will persist, and no internationally agreed-upon definition.*

**4.4.2.** For a given project, a buffer pool of non-tradeable credits shall be established, taking into account the risk of non-permanence of RF reductions, the risk related to data accuracy, and other project risk.

***NOTE:** RF Reductions encompass climate forcer emission reductions and removals, as well as reductions in other positive climate forcers.*

**4.4.3.** For projects deemed to have a low risk of reversal, a 2% buffer pool default shall be established. For projects that have a higher risk of reversal, a minimum default buffer pool size for registered projects shall be 10% of total credits issued, or the buffer pool size specified in the applicable Methodology, whichever is higher. This buffer pool size is subject to review by the VVB on a project-by-project basis at the time of project verification, and may be increased as warranted during the crediting period based on a risk assessment.

***NOTE:*** *Examples of projects that would likely have a higher risk of reversal include land-based projects, including agricultural, forestry, grassland, and wetland projects, that revolve around land use or management modifications, and carbon-storage projects, including land-use and technology-driven projects, aimed at sequestering carbon.*

**4.4.4.** The Project Proponent shall monitor the project for reversals in RF reductions, and provide updates in the *Monitoring Report*, developed using the *Project Monitoring Report Template*. For projects with risk of reversals, the Project Proponent must develop a Risk Mitigation Plan that includes a description of risks identified and how risks of reversal will be minimized. The Risk Mitigation Plan shall be updated as part of the *Monitoring Report*, and will be made publicly available through the Registry platform.

***NOTE:*** *ISO 31000 is a recommended framework.*

**4.4.5.** In the event that a project's conditions change, leading to an unintentional reversal of RF reduction, the Registry shall cancel buffer credits in an amount equivalent to the lost credits associated with the reversal.

**4.4.6.** In the case of an intentional reversal, the Project Proponent shall be required to deposit into the buffer pool an amount equivalent to the volume of credits cancelled by the Registry to address the loss. In addition, the project shall be temporarily suspended from issuing credits, and evaluated by the Registry to reassess the risks of continuation. The VVB shall make its recommendation to the Registry for final determination.

**4.4.7.** The VVB shall review the buffer pool size and risk conditions during regularly scheduled verification assessments.

**4.4.8.** The Project Proponent shall monitor the project for secondary effects (i.e., leakage) and the risk of such effects – i.e., increases in positive RF levels that occur outside the project boundary as defined in the applicable Methodology, but that are nonetheless affected by the project. Any such effects shall be accounted for in the final RF reductions claimed as stipulated in the applicable Methodology.

### 4.5. Prevention of Double Counting

**4.5.1.** Verified credits shall be tracked upon purchase, resale, or assignment. Retirement shall be at the discretion of the Purchaser, and shall be recorded in the Registry.

**4.5.2.** Reductions in positive RF that are validated and verified under the Registry, and the GHG reductions and removals associated with such RF reductions, shall not be included under any other emissions trading programs, environmental markets, projects seeking credits for indirect GHG emissions reductions and/or removals, or be used to meet a regulatory compliance obligation.

**4.5.3.** Projects boundaries that overlap with other projects on the Registry or on other emissions reduction/removals projects are disallowed.

**4.5.4.** An attestation of no double counting from the Project Proponent is required to be provided to the VVB at the time of the credit verification. The *Project Proponent Agreement* signed by the Project Proponent at the outset of the project also addresses the issue of double counting.

# 5. PROJECT REQUIREMENTS

*Projects shall be well conceived, described, and documented at each stage to establish a strong basis for independent validation, verification, and issuance of credits.*

### 5.1. General Requirements

**5.1.1.** Projects shall meet all applicable rules and requirements of the Registry, including the requirements of this Standard and the applicable Methodology.

**5.1.2.** Projects shall adhere to the principles in Section 3.

**5.1.3.** Projects shall be implemented in accordance with applicable local and national laws and regulations.

**5.1.4.** Project documentation shall be collected in accordance with the requirements of this Standard and the applicable Methodology.

**5.1.5**. Project sites may be grouped within one project if they are:

a. in conformance with the same Methodology;
b. utilize the same technologies;
c. are all included in the project's initial validation;
d. are located within the same geographic area; and
e. are overseen by the same Project Proponent or appointed representative.

***NOTE**: The Registry will make the final determination related to project grouping, based on evidence provided by the Project Proponent and reviewed by the VVB.*

**5.1.6.** The Project Proponent shall open a Registry account and enter into a *Project Proponent Agreement* with the Registry before a specific project may be listed on the Registry platform. Validation and verification may only take place upon the project's listing on the Registry platform.

***NOTE:** Program forms are accessed through the Registry website.*

**5.1.7.** The Project Proponent shall provide the Registry with any clarifications and corrections it requests related to the Standard or associated Methodology prior to commencing validation.

**5.1.8.** The Project Proponent shall follow the requirements described in this Standard, and the steps outlined in the *Project Proponent Manual*.

**5.1.9.** The Registry may accept, at its sole discretion, a project that has been rejected by another carbon credit program due to procedural or eligibility requirements, if the project meets all Registry requirements. In such a case, the Project Proponent shall:

a. Include a statement in the *Application Form* and *Project Design Document* that lists all other programs to which the Project Proponent has applied for registration, was rejected, and the reason(s) for the rejection. Such information shall not be considered commercially sensitive information.

b. Provide the formal rejection document(s), including any additional explanation, to the Registry and the VVB conducting the validation.

### 5.2. Project Ownership and Proof of Right

**5.2.1.** The Project Proponent shall either demonstrate that it is the legal owner of the project to be evaluated (i.e., with the right to control and operate the project activities) or shall identify the legal owner(s).

**5.2.2.** The Project Proponent shall identify the organization(s) with the right to claim the verified credits generated by the project, which may or may not be the Project Proponent, and provide associated evidence.

**5.2.3.** If the Project Proponent has one or more implementation partner(s), the Project Proponent shall indicate whether that partner has a direct ownership stake in the project or right to claim any portion of the verified credits generated by the project and provide evidence of such arrangement to the VVB.

### 5.3. Project Design Document and Reporting

**5.3.1.** The Project Proponent shall develop a *Project Design Document* for each crediting period by completing the information required in the *Registry Project Design Document Template*, including the following elements:

a. Project title, purpose(s), and objective(s);
b. Project location(s), including geographic and physical information allowing the unique identification and delineation of the specific extent of the project;
c. Project description, including project activities, technologies, products, services, and the expected level of activity;
d. Applicable project type and Methodology;
e. Roles and responsibilities, including contact information of the Project Proponent, the project implementation partner (if different), other participants, regulator(s), and interested stakeholders as relevant;
f. The intended start date for initiating project activities, the intended date of project termination, and the project crediting period, including relevant activities in each step of the project cycle;
g. A project monitoring plan, including a description of protocols, methods and resources for monitoring, reporting, and verification (MRV) of the project's outcomes, and the intended frequency of monitoring and reporting;
h. A description of how the project will comply with local, national, and international laws and regulations.
i. A plan for managing data, including data collection, storage, analysis, and reporting.
j. A description of how the project (or cohort of sites within a grouped project, if applicable) will achieve RF reductions;
k. A description of the baseline scenario if the project is not undertaken,
l. A description of the project scenario if the project is initiated;
m. An estimate of anticipated reductions, removals, or increases in climate forcers, including an inventory of the specific emissions or other climate forcers to be reduced or removed, and the time required to scale up the project and assumptions within the crediting period;
n. The additionality case for the project per Section 5.5;

o. A description of the project boundaries consistent with the Methodology(ies), including maps, coordinates, and written description of sites and activities associated with the project (see also 2.3 and 2.4);
p. Identification of risks that could affect the project's verified climate benefits (e.g., secondary effects, non-permanence);
q. Justification for any climate forcers included in the associated Methodology but not included or specifically excluded from regular monitoring;
r. A description of potential life-cycle co-benefits anticipated during the crediting period, and the approach and assumptions that may be used to confirm these co-benefits;
s. A description of potential trade-offs anticipated during the crediting period, and the approach and assumptions that may be used to confirm these trade-offs;
t. A description of any third-party certification already completed or planned under an internationally recognized scheme that provides documentation of conformance to selected indicators under the UN SDGs; and
u. A description of relevant activities and outcomes from stakeholder consultations and mechanisms for on-going communication.

***NOTE**: Assumptions for trade-offs should incorporate projections of threshold exceedances that could occur (e.g., exceedance of government legal limits, international consensus thresholds, biophysical thresholds), reported with uncertainty estimates of the likely dispersion of values and a qualitative description of the likely causes of the dispersion.*

**5.3.2.** The Project Proponent may request project-specific deviations to an existing approved Methodology if such deviations are more accurate and/or conservative than the approved Methodology's approach to the quantification of RF reductions, or other key principles listed in Section 3. The Registry shall review the request and any supporting evidence provided by the Project Proponent confirming that the proposed alternative will not undermine the conservativeness of calculations or any other key principles, and make a determination to grant the deviation at its sole discretion.

**5.3.3.** The Project Proponent shall make the *Project Design Document* available for public review (the "Public Comment Period"), and it will be posted on the Registry website. Commercially sensitive information may be redacted from the document prior to publishing for comment, but must be available to the Registry for review. Response to the public comments and issue resolution will be posted publicly.

a. The Registry shall review any information designated by the Project Proponent as proprietary to determine if it meets the Registry's definition of commercially sensitive information within the context of the validation.
b. At a minimum, information related to the determination of the project and baseline scenario, demonstration of additionality, anticipated outcomes, estimation of reductions/removals, identification of risks, description of potential co-benefits and trade-offs, and input from stakeholders shall not be considered commercially sensitive and shall be provided in the public versions of the project description.

***NOTE**: All project information is assumed to be available for public scrutiny, unless identified by the Project Proponent as commercially sensitive, and must be made available for review by the VVB and the Registry, subject to non-disclosure agreements as needed. Demonstration that such information is commercially sensitive shall be incumbent on the Project Proponent and approved by the Registry and the VVB.*

### 5.4. Baseline and Project Scenarios

**5.4.1.** Consistent with Section 5.3.1, the Project Proponent shall identify, justify, and monitor:

a. The project and baseline scenario description;
b. Relevant climate forcers;
c. Data availability, reliability, and limitations;
d. Other relevant information concerning present or future conditions, such as legal, technical, economic, sociocultural, environmental, geographic, site-specific, and temporal assumptions or projections;
e. Existing government policies and legal requirements that lower GHG emissions (e.g., feed-in tariffs for renewable energy, minimum product efficiency standards, air quality requirements or carbon taxes). Where legal requirements exist but enforcement is lacking, the enforcement gap should be well-documented; and
f. Assumptions, values, and procedures that help ensure that reductions/removals are not overestimated.

**5.4.2.** The Project Proponent shall demonstrate equivalence in the type and scale of activity of products or services provided between the project scenario and baseline scenario, and explain, as appropriate, any significant differences between the two scenarios.

**5.4.3.** The reduction in positive RF between the project and baseline scenario shall be at least 5%, after accounting for uncertainties. The determination of uncertainty must follow the procedures outlined in the applicable Methodology. All potential sources of uncertainty must be quantified and incorporated into the RF reduction calculations and aggregated into a combined uncertainty estimate. The 5% threshold must be met with a 90% confidence level.

**5.4.4.** As applicable by project type, the Project Proponent shall agree to set aside a portion of verified credits for inclusion in a credit buffer pool in an amount deemed appropriate consistent with the Methodology and with Clause 4.4.3 above, and based on a risk analysis of the project.

### 5.5. Additionality

**5.5.1.** Consistent with Section 5.3.1, the Project Proponent shall provide information in the *Project Design Document* to support the case for additionality. A project shall be considered additional if:

a. The project activities are over and above governmental mandates and enforcement as of the project start date in the jurisdiction in which the project is located, including any existing law, regulation, statute, legal ruling, or other regulatory framework in effect.
b. The project activities, approach, or technologies are not in common practice in the industry sector, within the relevant geographic area.
c. The capital required for the project activities is generally unavailable or inadequate in the local market without the sale of credits, or the technical expertise to conduct the project activities is not available in the region, or there are institutional or cultural hurdles to adoption of the project approach, technology, or practice within the relevant geographic area, and carbon market incentives are required to overcome these hurdles.

**5.5.2.** The Project Proponent shall provide information as requested by the VVB to support an independent confirmation of the additionality designation. Such information may include a barrier analysis and performance standards and benchmarks, where appropriate.

**5.5.3.** Once a determination of additionality is made, it shall be applied throughout the current crediting period, but shall be reassessed by the VVB within two years of the end of the crediting period.

### 5.6. Assessing Risks Related to Non-Permanence and Secondary Effects

**5.6.1.** The Project Proponent shall evaluate the risk of secondary effects (i.e., leakage) as directed within the applicable Methodology, taking into consideration potential sources of unintended effects, such as:

a. Adjacent project areas:
   1) The project area is defined as the full area within the authority of the Project Proponent.
   2) Areas immediately around the project area that serve as carbon storage areas (sinks, sources, and reservoirs) are included in the project.
b. The supply chain:
   1) Scope 1 – direct emissions
   2) Scope 2 – emissions due to purchased energy
   3) Scope 3 – indirect emissions in the value chain (upstream and downstream)
c. Sale of the project output as an intermediate feedstock or component of another manufacturing process
d. When fuel sources include biomass, if the source of the feedstock is renewable.

**5.6.2.** The Project Proponent shall evaluate the risk of non-permanence at each monitoring period, consistent with the applicable Methodology.

**5.6.3.** If a reversal of emissions is deemed to have occurred based on verification reports, buffer credits shall be used as replacement, and future issuances shall replenish the buffer pool. If reversals are due to *force majeure,* the Project Proponent shall notify the Registry in writing within one week, and submit a report within six months after the *force majeure* event.

**5.6.3.** The Project Proponent shall confirm that any project aimed at increasing or restoring surface and non-emissions-related albedo (i.e., to achieve negative RF) is consistent with applicable multilateral environmental agreements and statutory and regulatory requirements, whether international, national, regional, or local.

***NOTE*:** *Such efforts could include, for instance, the restoration and protection of sensitive and critical ecosystems (i.e., coral reefs, phytoplankton), and the mitigation of urban heat islands through the use of white and reflective roofs, streets, and surfaces.*

### 5.7. Calculating Reductions and Removals

**5.7.1.** All GHG reductions and removals shall be calculated in accordance with the requirements of ISO 14064-2:2019. All RF calculations shall be based on the methods described herein and in normative Appendix A.

**5.7.2.** The RF reduction potential projected in the *Project Design Document*, as well as the actual reductions in positive RF achieved by the project, shall be determined for all relevant climate forcers, consistent with the applicable Methodology, by comparing the project and baseline scenarios within the system boundaries over the monitoring period.

**Equation 1: Quantifying reductions in positive RF associated with a given project.**

$$\Delta RF(t) = RF_{Baseline}(t) - RF_{Project}(t)$$

Where:

- t is the year.
- $\Delta RF(t)$ is the RF reduction potential in global mean RF in year t.
- $RF_{Baseline}(t)$ is the RF associated with the baseline scenario in year t.
- $RF_{Project}(t)$ is the RF associated with the full implementation project (or project type) scenario in year t.

**5.7.3.** Determination of the reduction in positive RF shall adhere to the following conditions to ensure consistency with the key principles identified in Section 3:

a. The data and methodologies used to quantify RF reduction and other aspects are relevant and appropriate.
b. Data sources and methods used are relevant and consistent, allowing for meaningful comparisons in climate forcer-related information.
c. The calculated RF reductions are accurate and precise.
d. The quantified RF reduction is conservatively low. When relying upon highly uncertain data and information, the Project Proponent should select assumptions and values that ensure that the quantification does not lead to over-estimations.

**5.7.4.** Baseline scenario calculations shall factor in the variability of RF, which could necessitate the use of multi-year averages. In such cases, one of the following multi-year approaches should be used, depending on data availability, prioritized in the order listed.

a. Project performance averaged over at least 3 years
b. Industry performance for the best 50% of performers over at least 3 years
c. Industry performance averaged over at least 3 years
d. Regulatory requirements

Any multi-year average used should conform with any applicable regulatory requirements, consistent with Clause 5.1.3.

**5.7.5.** The RF reduction potential for each relevant climate forcer shall be determined for the project and baseline scenarios, projected each year over the defined period of interest for the analysis. The period of interest should be determined based on a reasonable timeframe for implementation and monitoring of the project.

### 5.8. Monitoring

**5.8.1.** The Project Proponent shall establish a system for compiling data and information needed to monitor, quantify, and report reductions/removals relevant for the project (including secondary effects) and baseline scenario.

**5.8.2.** The Project Proponent shall document project inconsistencies with the *Project Design Document*, including relevant assumptions and qualitative or quantitative levels of uncertainty.

**5.8.3.** The Project Proponent shall monitor the project for any changes in processes, materials, or activities that could potentially change the level of RF reduction projected to occur, and prepare an Incident Report

to document the change(s). Incident Reports shall be prepared within 30 days of the reported changes, and include a description of the nature, timing, scale, and likely permanence of the change.

**5.8.4.** If measurement and monitoring equipment is used, the Project Proponent shall ensure that the equipment is calibrated according to good practice and consistent with any specifications provided in the applicable Methodology.

**5.8.5.** If changes in processes, materials, or activities are observed that could alter the level of RF reduction, the Project Proponent shall describe the nature, timing, scale, and likely permanence of the change in the Monitoring Report.

**5.8.6.** The Project Proponent shall prepare a *Monitoring Report* spanning the monitoring period, based on the *Project Monitoring Report Template*, to be submitted to the VVB during verification. Once the VVB has completed its verification review and made any necessary corrections or revisions to the *Monitoring Repor*t, it shall be submitted to the Registry. The report shall include the following elements:

a. Project title;
b. Project location(s);
c. Any updates to the system boundaries, project activities, and sites;
d. Monitoring period start and end dates;
e. A project operations and activities update describing the current status and conditions of the project;
f. Details of the data monitored, including reductions or increases in RF (with an inventory of the specific emissions or other climate forcers reduced, removed or increased), and known or anticipated co-benefits and trade-offs;
g. Deviations from the *Project Design Document*, including justification for differences between ex-ante and actual RF reductions;
h. Identification of risks that could substantially affect the project's verified climate benefits, related to materiality, uncertainty, secondary effects, and non-permanence;
i. Any Incident Reports prepared during the monitoring period;
j. Any updates from stakeholder consultation or communications;
k. Any updates related to third-party certifications under internationally recognized schemes; and
l. Signed attestation pertaining to the continuing regulatory compliance (including disclosure of violations or other instances of non-compliance with laws, regulations, or other legally binding mandates directly related to project activities), ownership, avoidance of double counting, and known or likely changes in climate co-benefits and trade-offs.

### 5.9. Social and Environmental Impacts, Co-Benefits, Trade-Offs, and SDGs

**5.9.1.** The Project Proponent shall comply with national and local laws and regulations and, where relevant, international conventions and standards.

**5.9.2.** The Project Proponent shall assess associated risks of negative environmental and social impacts, taking into account the scope and scale of the project activities.

**5.9.3.** The Project Proponent shall identify methods of minimizing, mitigating, or offsetting any trade-offs identified, observing a 'No Net Harm' principle as defined by CORSIA. Information on measures

implemented shall be recorded and described in the Registry database system and reported along with credits for consideration by potential purchasers.

*NOTE: All human activities use some energy and materials and therefore cause some environmental impacts. The goal is to do no harm, by minimizing these impacts to the extent possible, and disallowing projects in which such impacts cannot be substantially mitigated.*

**5.9.4.** The Project proponent shall affirm and demonstrate that the project:

a. Provides safe and healthy working conditions;
b. Ensures fair treatment, avoiding discrimination;
c. Prohibits forced labor, child labor, or trafficking;
d. Provides equal pay for equal work;
e. Provides equal opportunities across genders;
f. Addresses gender-based violence; and
g. Requires validated documentation of safeguards.

**5.9.5.** All known categories of potential environmental and human health impact co-benefits and trade-offs associated with specific project scenarios shall be identified, consistent with the applicable project type-specific Methodology, which will include a survey of the scientific literature. Identification of relevant co-benefits and trade-offs shall take into consideration:

a. Impacts associated with human activities (e.g., activities leading to energy consumption, ocean acidification, regional acidification, ground level ozone, albedo change, PM 2.5);
b. Observed impacts in similar conditions;
c. Location of project activities or processes (e.g., processes in highly polluted regions or regions not subject to environmental regulation can be linked to multiple regional impacts);
d. The fate and transport of climate forcers (i.e., the dispersion, mixing and ultimate deposition or chemical transformation of a climate forcer upon release into the atmosphere); and
e. Stakeholder input.

*NOTE: While climate change is associated with impacts such as temperature rise, warming oceans, thermal expansion of oceans, and heat impacts on ecosystems, co-benefits and trade-offs refer to those impacts to human health and the environment that are distinct from the climate change impacts.*

At a minimum, the impact categories in Table 2 (Clause 2.4.1 above) shall be considered.

**5.9.6.** The Project Proponent shall consider co-benefits and trade-offs in terms of their scale, geographic range, duration of effect, and in the case of trade-offs, whether they might exceed government-established thresholds. The Project Proponent shall identify areas of uncertainty with respect to relevant impacts.

**5.9.7.** Co-benefits and trade-offs that are quantified consistent with Appendix A shall be recorded in the Registry database system, reported along with credits, and mapped to applicable UN Sustainable Development Goal targets. The Project Proponent shall provide updates in the project monitoring reports.

**5.9.8.** For projects that have been third-party certified under an internationally recognized scheme, if that certification confirms additional social, environmental or socio-economic co-benefits not already addressed under Table 2, these co-benefits may also be mapped to applicable UN SDG targets, and reported along with credits for consideration by potential purchasers.

### 5.10. Stakeholder and Public Input

**5.10.1.** The Project Proponent shall identify stakeholders who could be affected by the project, including stakeholders:

a. with legal rights, or customary tenure and access rights, to territories and resources, including collective or conflicting rights;
b. in proximity to the project that could be affected by the project (representative of the socio-economic and cultural diversity of the population);
c. indigenous individuals, communities, or sovereign nations that might be directly affected by project operations; and
d. outside the area of the project but affected by the project.

Project implementation shall be in line with applicable international human rights law, the United Nations Declaration on the Rights of Indigenous Peoples, and ILO Convention 169 on Indigenous and Tribal Peoples.

**5.10.2.** The Project Proponent shall establish procedures for meaningful two-way communication with local stakeholders on an ongoing basis to provide a means for stakeholders to raise concerns about potential negative impacts associated with the project, from project conception through implementation. Project Proponents shall include local stakeholders as part of project design and implementation in a manner that is inclusive, culturally appropriate, and respectful of local knowledge, cultural heritage, and language, and take these consultations into account. The information shall provide sufficient detail and substance for stakeholders to engage effectively on such issues.

**5.10.3.** The Project Proponent shall provide transparency about the way in which stakeholder feedback has been taken into consideration in the decision-making process and how grievances have been resolved. Documentation pertaining to stakeholder engagement shall be maintained.

**5.10.4.** The Project Proponent shall review stakeholder input at least annually to determine whether steps are needed to address any concerns raised, or to justify why no updates or changes to the project are needed.

**5.10.5.** The Project Proponent shall agree to have the *Project Design Document* posted on the Registry for public comment for a period of at least 30 days prior to implementation, review such comments, and determine if such comments warrant project modifications, or demonstrate the insignificance or irrelevance of the comment. Response to the public comments and issue resolution shall be posted publicly.

Additional means of Registry public consultation are detailed in the Governance Framework document(s).

Commented [JN2]: Note for QA: The Governance Framework document is on hold as we resolve a question on the legal entity where the registry resides. If you think putting this doc out for public consultation with out the Gov Framework also being available, we can delete this line.

**5.10.6.** Where such stakeholders have been identified under 5.10.1, the Project Proponent shall comply with the Free, Prior and Informed Consent guidance in Appendix B.

### 5.11. Recordkeeping

**5.11.1.** The Project Proponent shall agree to have its GHG reductions or removals and RF increases or reductions associated with the project reported on the Registry.

**5.11.2.** The Project Proponent shall establish and maintain procedures for document retention and record keeping related to the requirements of this Standard for a period of at least five years after the end of the

crediting period, or longer if specified in the applicable Methodology, depending on the duration of the project.

**5.11.3.** The Project Proponent shall make all relevant information, including the *Project Design Document*, *Monitoring Reports*, and all supporting information and data, available to the VVB during validation and verification assessment(s).

**5.11.4.** The Project Proponent shall acknowledge receipt of each Validation and Verification finding prepared by an authorized VVB and resolve any outstanding corrective actions, as determined by the VVB, from such findings within six months of receipt in order to be eligible to have the project validated and the credits verified.

# 6. VALIDATION AND VERIFICATION REQUIREMENTS

*Independent validation and verification assessments shall be conducted by third-party validation and verification bodies (VVBs) approved by the Registry.*

### 6.1. VVB Qualifications

**6.1.1.** All project validation and verification shall be conducted by a qualified third-party validation and verification body (VVB) that meets the following requirements:

a. conforms to international standards for environmental verification, "General principles and requirements for bodies validating and verifying environmental information" (ISO 14065:2020), "Conformity assessment – General principles and requirements for validation and verification bodies" (ISO/IEC 17029:2019), and "IAF Mandatory Document for the Application of ISO 14065" (IAF MD 6:2023); and
b. has been vetted and approved in advance by the Registry or a Registry-approved accreditation body to confirm competence to perform the assessments required under the Registry Program, and enumerated in the *VVB Manual*.

### 6.2. Purpose of Validation and Verification Assessments

**6.2.1.** The purpose of the validation is to:

a. assess conformance of the project to the Standard and applied Methodology requirements;
b. reduce the uncertainty of the project; and
c. confirm the baseline and project scenarios.

**6.2.2.** The purpose of the verification is to assure the credit purchaser that the credits issued accurately reflect the claimed project achievements. The verification shall independently assess:

a. at least one year of operations;
b. the relevance of the data sources and methods used,
c. the accuracy of calculations conducted,
d. the use of conservative assumptions;
e. the veracity of the validated scenario;
f. the conformance of the implemented project to the Standard, the applied Methodology, and *Project Design Document*;
g. documentation of the project activities throughout the monitoring period and the accuracy of the reductions or increases in RF; and
h. performance requirements as defined by the VVB or technical subject matter experts.

**6.2.3.** Site visits shall be conducted at a minimum frequency as designated in the Methodology, or more frequently if determined necessary by the VVB.

### 6.3. Timing of Validation and Verification Assessments

**6.3.1.** Validation shall be conducted after completion of the *Project Design Document*. This may occur before or after operations are initiated, and must occur within a timeframe specified in the Methodology. The validation confirms that the *Project Design Document* provides a reasonable basis for meeting the requirements of the program.

**6.3.2.** Validation shall occur once per crediting period. Initial validation typically shall occur before the onset of Project operations, or if the project has already begun operations when it is registered, validation shall commence no later than one year after registration. Subsequent re-validation shall occur at the start of a renewed crediting period.

**6.3.3.** If the project deviates from any aspect of the *Project Design Document* after the validation, these changes must be disclosed in the *Monitoring Report* and validated in conjunction with the associated verification.

**6.3.4.** Verification shall be conducted after operations are initiated, within a timeframe specified in the Methodology. Verification may only occur after monitoring and reporting have been completed. The scope of the verification shall include the following:

a. the Project has been implemented and is operating in conformance with the Standard, the *Project Design Document*, and the applicable Methodology;
b. any changes in processes or activities since the last verification have been documented;
c. accuracy of the GHG reductions/removals and RF reductions within a materiality threshold of ±5%;
d. co-benefits and SDG indicators, and trade-offs associated with the project; and
e. confirmation that other requirements of the Registry program are met.

**6.3.5.** Validation and initial verification may be conducted simultaneously if the project has already begun operations when the Project Proponent engages with the Registry, provided that the initial verification occurs only after monitoring and reporting has been completed. Subsequent verifications shall be conducted at regular intervals as specified in the applicable Methodology.

**6.3.6.** Validation and initial verification of the project may be undertaken by the same VVB.

**6.3.7.** The VVB shall be rotated at least every five years for verification, or at least every three years if the crediting period is five years or less.

### 6.4. Validation and Verification Process Steps and Report Submissions

**6.4.1.** The VVB shall conduct the validation in accordance with the following steps:

a. Review the *Project Design Document* and any supporting documentation;
b. Confirm the case for additionality, or the likelihood of the additionality if the project start date has not yet occurred;
c. Conduct an on-site audit in conformance with the Registry Standard and the applicable Methodology;
d. Assess the reasonableness of the assumptions, limitations, and methods used to determine the RF reduction potential of the project scenario compared to the baseline scenario;
e. Prepare a Validation Report for review by the Project Proponent, including key assumptions, an explanation of any limitations encountered in the application of key principles, and description of the findings and corrective actions required to be completed for the Project to achieve validation;
f. Review corrective actions taken;

g. Determine with a reasonable level of assurance that the Project conforms with all applicable Registry program criteria;
h. Finalize the Validation Report to reflect any updates, if applicable; and
i. Prepare and sign a final Validation Opinion, accompanied by a signed VVB Reliance Letter, and submit to the Registry.

An independent technical reviewer from the Registry shall review the Validation Report. The Registry reserves the right to accept or reject a validation opinion from an approved VVB based on VVB performance, and conformance with the Standard and Methodology requirements.

**6.4.2.** The VVB shall conduct the verification in accordance with the following steps:

a. Review the *Project Design Document* and the *Monitoring Report*, the details of project implementation and any additional supporting documentation;
b. Confirm the additionality assessment;
c. Conduct an on-site audit in compliance with the Standard and the applicable Methodology;
d. Assess the accuracy of the stated GHG reductions/removals and the corollary increase or reduction in RF, and confirm that the stated credits to be issued within the project monitoring period meet a materiality threshold of ±5%;
e. Evaluate any secondary effects, reversals, or increases in risk of permanence;
f. Prepare a Verification Report, including key assumptions, an explanation of any limitations encountered in the application of key principles, and describe findings and corrective actions required to be completed for the Project to achieve verification;
g. Submit Verification Report for independent internal technical review;
h. Submit technically reviewed Verification Report for review by the Project Proponent;
i. Review corrective actions taken by Project Proponent, if applicable;
j. Determine with a reasonable level of assurance that the project conforms with all applicable Registry program criteria;
k. Finalize the Verification Report to reflect any updates, if applicable; and
l. Prepare and sign a Verification Opinion, accompanied by a signed VVB Reliance Letter, and submit to the Registry along with Verification Report.

Registry reserves the right to accept or reject a verification opinion from an approved VVB.

### 6.5. Materiality

**6.5.1.** Discrepancies between the reduction in positive RF claimed by the Project Proponent as compared to the RF reduction determined by the VVB for a given monitoring period shall not exceed a materiality threshold of ±5%.

**6.5.2.** The VVB shall select samples of data and information to be verified that provide a reasonable level of assurance.

**6.5.3.** Where specific reductions in positive RF are estimated for the baseline or project scenario, the VVB shall assess the credibility of the source for emission factors or removal factors for specific climate forcers.

### 6.6. VVB Oversight

**6.6.1.** In addition to the VVB accreditation and approval requirements described in Section 6.1, the Registry reserves the right to provide oversight of any activities conducted by the VVB during the course of validation and/or verification assessments to ensure an adequate level of quality control and supplement the audit processes. Such oversight activities may include reviews, spot checks, or witness audits:

a. Information and documentation pertaining to VVB conflict of interest-;
b. VVB data analyses;
c. Evidence gathering plans;
d. Project Proponent documentation such as data sources, quantification methodologies, and calculation spreadsheets or databases;
e. Review of Validation Reports, Validation Opinions, Verification Reports, and Verification Opinions;
f. Project-level audits and site visits;
g. Validation or verification meetings;
h. Project Proponent and/or VVB documentation for new methodologies.

**6.6.2.** The Registry will provide advance notification to the VVB and the Project Proponent for any planned project-level audit. During a project-level audit, the Registry may send, at its own expense, a representative to the validation and/or verification site visit to observe on-site verification activities. The Registry may also conduct ad-hoc spot checks.

**6.6.3.** The Registry will report the results of its oversight activities to the Project Proponent and VVB, including any items of concern, and areas for improvement and non-conformities with Registry validation and verification procedures. The Registry will report significant, non-remediated or recurring VVB performance concerns to the relevant accreditation body.

**6.6.4.** The Registry reserves the right to suspend or revoke its approval of a previously approved VVB with cause.

## Change Log

Version 2.0: The following changes were made in this update:

| | |
|---|---|
| **General** | Updated version number and publication date throughout the document. |
| **New Section** | Added a formal Change Log section before the Appendices |
| **Section 2.2** | Added information about eligible project types. |
| **Section 2.3** | Enhanced detail on climate forcers documentation required in the Project Design Document. |
| **Section 2.4** | Expanded and clarified co-benefits, trade-offs, and SDG alignment, including new impact categories. |
| **Section 3.1** | Clarified measurement conservativeness language. |
| **Section 4.1** | Clarified who sets the price of credits and the unique serial numbers of credits. |
| **Section 4.3** | Clarified measurement requirements for renewal periods. |
| **Section 4.4** | Added guidance on Risk Mitigation Plans. |
| **Section 4.5** | Clarified language on project boundaries and overlapping projects. |
| **Section 5.3** | Clarified the process for public comment on Project Design Documents. |
| **Section 5.4** | Added language on government policies and legal requirements in baseline and project scenarios. |
| **Section 5.5** | Added language to clarify documentation of additionality |
| **Section 5.6** | Added language to evaluate the risk of secondary effects (leakage) |
| **Section 5.9** | Strengthened social and environmental safeguards, including alignment with CORSIA's "No Net Harm" principle and gender equity provisions. |
| **Section 5.10** | Expanded stakeholder engagement requirements, including annual review of feedback and FPIC compliance. |
| **Section 6.6** | Additions on VVB spot checks and conflict of interest documentation |
| **Appendix B** | Added new appendix on Free, Prior and Informed Consent (FPIC). |

# Appendix A (Normative)
# Calculating Project-Related Radiative Forcing Values

This Appendix, derived from the Radiative Forcing Protocol, describes the methods, equations, and default values used to determine the inventory of climate forcers and to calculate the radiative forcing reduction associated with the relevant climate forcers in the baseline and project scenarios of a project. This appendix should be used in tandem with the instructions provided in the applicable, project type-specific Methodology.

### A.1. Baseline and Project Scenario

The RF associated with a baseline or project scenario shall be quantified in each year using Equation A.1.

**Equation A.1. General equation for quantifying RF for a given year ($t_F$) considering all climate forcer effects occurring between $t_0$ and a later time $t_F$, expressed in W/m$^2$ or t $CO_2$fe.**

$$RF(t_F) = RF_{WMGHG}(t_F, t_0) + RF_{TOPr}(t_F, t_0) + RF_{NWMCF}(t_F, t_0) + RF_{non-emission\ CFs}(t_F) + RF_{reduced\ negative}(t_F)$$

Where:

- $t_F$ is the year in which the radiative forcing value is calculated (typically, the most recent 12-month period for which data are available)
- $t_0$ is the first year in the analysis timeframe
- $RF_{non\text{-}emission\ CFs}(t_F)$ is the radiative forcing in year $t_F$ from activities that are not associated directly with emissions.
- $RF_{reduced\ negative}(t_F)$ is the radiative forcing in year $t_F$ that results from the reduction of negative climate forcers.
- $RF_{WMGHG}$ is the radiative forcing from emissions of well-mixed greenhouse gases, including the influence of legacy emissions on current RF.
- $RF_{TOPr}$ is the positive radiative forcing from secondary climate forcers formed from tropospheric ozone precursors.
- $RF_{NWMCF}$ is the radiative forcing from non-well-mixed climate forcers.

*NOTE: Negative RF shall not be included in an aggregation used for calculating RF footprints, except for negative forcers of decreasing magnitude*

### A.2. Relevant Climate Forcers

All climate forcers relevant to the project type shall be considered, whether they are linked to positive or negative RF, across the entire analysis timeframe. This includes all known emissions that cause direct RF, as well as those that affect RF indirectly, such as through chemical reactions in the atmosphere and effects on cloud cover.

***NOTE:*** *Inclusion of climate forcers is based on the significance of their contribution.*

Figures 1.a and 1.b summarize the range of climate forcers to be considered, and show how this augments the climate forcers included in conventional carbon footprints.

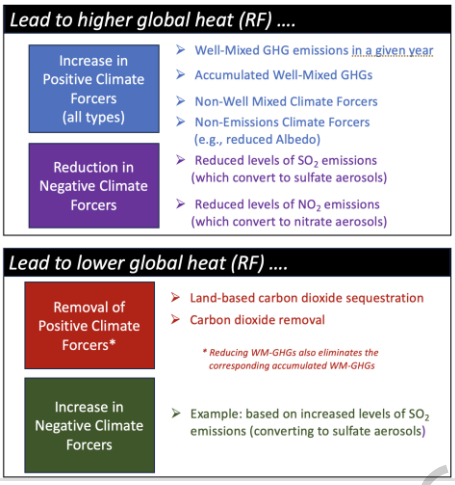


**Figure 1.a. The contribution of climate forcers to excess global heat**

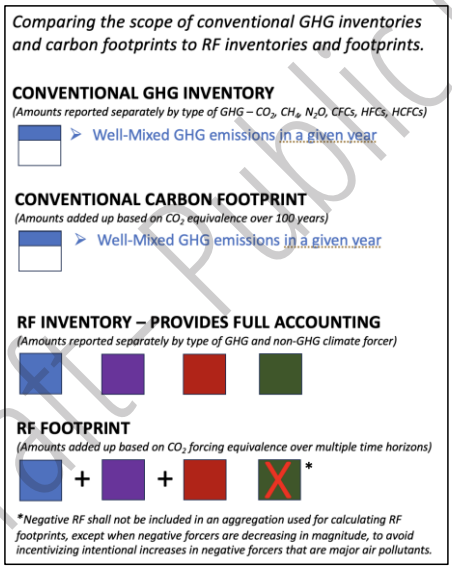


**Figure 1.b. Conventional GHG inventories and footprints are a subset of RF inventories and RF footprints**

*NOTE: Box colors correspond with boxes in Figure 1.a. Partial blue box indicates that while WM-GHGs are included, other increases in positive climate forcers are not included.*

The following non-emission climate forcers shall be included, provided that the scale of the related RF change is significant:

- Black carbon emissions, as well as deposition of black carbon and other darkening materials on light surfaces (e.g., snow, ice), which is accounted for when quantifying the RF related to black carbon emissions;
- Infrastructure-related land use changes that lead to a decrease of surface reflectivity;
- Albedo restoration (i.e., returning albedo to its pre-industrial period conditions, such as through eliminating destruction of Arctic Sea ice due to ship ice breaking, especially in spring and summer months, which removes high-albedo ice and replaces it with low-albedo seawater);
- Brightening (i.e., "cool roofs" or "cool roads") or darkening (i.e., from infrastructure construction) of urban areas, which can cause changes;
- Other land use changes, leading to either positive or negative RF changes (depending on the albedo modification); and
- Destruction of stratospheric ozone by Ozone Depleting Substances, especially by CFCs (which are accounted for when quantifying the RF related to CFC emissions).

**A.3. Calculating RF**

The RF related to emissions shall be calculated using Equation A.2.

**Equation A.2. Calculating the RF of a specific species of climate forcer over a defined analysis timeframe ($t_F$, $t_0$) from all sources.**

$$RF_{climate\ forcer}(t_F, t_0) =$$

**a. For Well Mixed GHGs:**

$$\sum_{i=WMGHG\ source} \int_{t_0}^{t_F} E_i(t) \times \mu RF(t_F - t_0)\, dt$$

**b. For non-well mixed climate forcers except Tropospheric Ozone precursors:**

$$\sum_{n\,=\,NWMCF\ source} E_n(t_F) \times RE_n$$

**c. For Tropospheric Ozone:**

$$\sum_{k=TOPr} \int_{t_0}^{t_F} E_k(t) \times \mu RF(t_F - t_0)\, dt$$

Where:

- $t_F$ is the year in which RF is being calculated.
- $t_0$ is the first year in the analysis timeframe.
- E(t) is the emissions of one source of a given species in year t, in tonnes.
- µRF(t) is the unit RF for the climate forcer in mW/(m² Tg) in year t, calculated using Equations A.3-A.6.
- RE is the radiative efficiency of the non-well mixed climate forcers.

For each climate forcer, the µRF (the RF resulting from the pulse emission of one million tonnes of a forcer) shall be quantified in Equation A.2 using Equation A.3 through Equation A.6, and associated Tables A.1 - A.5 (included in Equation A.6 below).

**Equation A.3. The RF resulting from the pulse emission of one million tonnes of $CO_2$ (i.e., the unit RF equation), from the IPCC Fifth Assessment Report.**

$$\mu RF_{CO2}(t) = RE_{CO2} \times \left( a_0 + \left( a_1 \times e^{-\frac{-t}{\tau_1}} \right) + \left( a_2 \times e^{-\frac{-t}{\tau_2}} \right) + \left( a_2 \times e^{-\frac{-t}{\tau_3}} \right) \right)$$

Where:

- t is the number of years after the pulse emission occurred.
- $RE_{CO2}$ is the radiative efficiency of $CO_2$, in mW/(m² Tg), which changes over time as the $CO_2$ concentration changes.[1)]
- The default values for the atmospheric concentration equation parameters ($a_0$, $a_1$, $\tau_1$, $a_2$, $\tau_2$, $a_3$, $\tau_3$) in Table A.1 are used unless more up-to-date values are available.

*1) A default value of 0.0017517 mW/(m² Tg) is used unless more up-to-date and accurate values are available [IPCC AR5, §8.SM.11.3.1]. This value can be used for projections up until 20 years in the future, after which the $CO_2$ radiative efficiency will change significantly, a factor that must be included to ensure accuracy in projections.*

**Equation A.4. The RF resulting from the pulse emission of one million tonnes of a non-$CO_2$ GHG (i.e., the unit radiative forcing equation), from the IPCC Fifth Assessment Report.**

$$\mu RF_{WMGHG}(t) = RE_{WMGHG} \times e^{-t/\tau}$$

Where:

- t is the number of years after the pulse emission occurred.
- $RE_{WMGHG}$ is the radiative efficiency of the well-mixed GHG, in mW/(m² Tg), which changes over time as the well-mixed GHG concentration changes. $RE_{WMGHG}$ from the latest IPCC report is used as a default (Table A.2).[1),2)]
- τ is the average atmospheric lifetime of the non-$CO_2$ well-mixed GHG, in years.[3)]

*1) Any radiative efficiency values that are converted into units of mW/(m² Tg) from W m$^{-2}$ ppbv$^{-1}$ follow the requirements of IPCC Fifth Assessment Report Chapter 8 Supplemental Material: "To convert RE values given per ppbv values to per kg, they must be multiplied by (MA/Mi)(10$^9$/TM) where MA is the mean molecular weight of air (28.97 kg kmol$^{-1}$), Mi is the molecular weight of species I and TM is the total mass of the atmosphere, 5.1352 x 10$^{18}$ kg."*

*2) For methane, $RE_{CH4}$ includes the following indirect effects that influence the radiative efficiency: formation of tropospheric ozone; effect on sulfate aerosols concentrations; effect on stratospheric water vapor; effect on nitrate aerosol concentrations; and from $CO_2$ formation [Shindell et al 2009].*

*3) For non-$CO_2$ well-mixed GHGs besides methane, τ from the latest IPCC reported is used as a default (Table A.2).*

**Equation A.5. The RF resulting from the pulse emission of one million tonnes of a non-well mixed climate forcers with an atmospheric lifetime of less than one year (i.e., the unit radiative forcing equation).**

$$\mu RF_{NWMCF}(t) = \begin{cases} \boldsymbol{RE_{NWMCF}\ when\ t < ARTMP} \\ \boldsymbol{0\ when\ t > ARTMP} \end{cases}$$

Where:

- t is the number of years after the pulse emission occurred.
- ARTMP is the Atmospheric Residence Time Modeling Parameter, in units of time, which is equal to or less than one year, and as a default one year.
- $RE_{NWMCF}$ is the radiative efficiency of the non-well mixed climate forcers, in mW/($m^2$ Tg).[1)]

*[1)] Evaluated as the average radiative forcing resulting from the pulse emission of one million tonnes of the NMWCF over the course of the ARTMP. If ARTMP is one year, then $RE_{NWMCF}$ is averaged over one year (see Table A.3 default values for sulfur dioxide, and Table A.4 for default values for black and organic carbon for ARTMP values of one year).*

Requirements for quantifying µRF for non-well mixed climate forcers with atmospheric lifetimes of less than one year shall be as follows:

- $RE_{NWMCF}$ considers the fact that these non-well mixed climate forcers are not evenly distributed in the global atmosphere and their impact varies regionally, and by source type.
- The following factors that affect the RF of these non-well mixed climate forcers are considered:
  - Rate of emission, weather conditions, location, timing (season, hour of day), and altitude of emission source. Data used to characterize RF from non-well mixed climate forcers are based on multiple years to minimize the effects of natural climate variability. This can be achieved by basing results upon average seasonal or average annual atmospheric concentrations of the non-well mixed climate forcers.
  - For all aerosols, indirect effects are characterized to the extent possible. This can involve use of conservative estimates. Examples include the enhancement of cloud albedo by sulfate aerosols, and deposition of black carbon on ice, snow and other reflective surfaces.
  - Other factors that can affect the RF are considered if they have a material effect.
  - Estimates of RF by source are obtained from peer-reviewed published research.
- When assessing the contribution to RF from black carbon, organic carbon, and brown carbon:
  - Direct observations of RF, if available, serve as the basis of the forcing of these climate forcers. Model-based quantifications based solely on bottom-up emissions estimates are compared to direct observations before being used to calculate the result. [NOTE: RF derived from climate models based on bottom-up emissions estimates have been found in some studies to underestimate black carbon concentrations by 3- to 10-fold (*Bond, T., 2013; Menon, S. 2010).]*
  - The RF per ton of black carbon differs significantly based on the region of emission, due to latitudinal differences in solar radiation, regional differences in baseline clouds, vertical transport of black carbon, underlying albedo, and vegetation cover. Differences based on the region in which black carbon is emitted are taken into account.
  - Special care must be taken when including brown carbon, the composition of which can be highly variable; as such, an analysis should be done for each specific situation. In most cases, the positive forcing from brown carbon is similar in magnitude to the negative forcing from organic carbon [*Feng, Y. et al, 2013; Chung, C.E. et al, 2012].* Accordingly, in the result, it can

be assumed as a default that RF from co-emitted brown and organic carbon aerosols offset each other. This assumption shall be recorded.
  - The enhanced RF resulting from deposition on ice and snow is included.
  - Indirect effects on clouds, to the extent they are relevant and can be estimated, are included.
  - For all carbonaceous aerosol emissions, the type of combustion is factored into the overall quantification. [NOTE: Black carbon emissions from fossil fuels are known to have different characteristics than black carbon emissions from open burning sources.]
- When assessing the contribution to RF from sulfate emissions, the following shall be included in the RF quantification:
  - The conversion rate of $SO_2$ emitted to sulfate ($SO_3$, $SO_4$).
  - Regional wash out rates and other meteorological factors affecting aerosol lifetime.
- Estimates of indirect radiative effects (i.e., cloud brightening effects).

**Equation A.6. Unit RF equation for a pulse emission of 1 million tonnes of a non-methane tropospheric ozone precursor.[1)]** *(Based on the metric calculations described in Section 5 of Fry 2012, with the land use term supplemented from Collins 2010.)*

$$\mu RF_{TOPr}(t) =$$

Tropospheric Ozone Effect(t) + Sulfate Effect(t) + Nitrate Effect(t) + Methane Effect (t) =

$$\left[TOPr_{O_3} + TOPr_{SO_4{}^{-2}} + TOPr_{NO_3^-}\right] + k \times \mu RF_{CH4}(t)$$

Where:

- t is the number of years after the pulse emission occurred.
- Tropospheric Ozone Effect represents the direct RF increase from the formation of tropospheric ozone.
- Sulfate Effect represents the perturbation of sulfate formation (resulting from NOx reactions to break down these aerosols – not relevant to precursors other than NOx).
- Nitrate Effect represents the generation of ammonium nitrate aerosols (in regions of high ammonia abundance).
- Methane Effect represents the enhanced atmospheric decay of methane resulting from ozone oxidation *[Collins, W.J. et al, 2013]*.
- $TOPr_{O3}$, $TOPr_{SO4}$, $TOPr_{NO3}$, are the respective magnitude of the non-methane tropospheric ozone precursor's indirect effects on tropospheric ozone, sulfates, and nitrates.
- k is a unitless value equal to the tonnes of methane oxidized per ton of TOPr emitted.
- $\mu RF_{CH4}$ (t) is the RF of one million tonnes of methane t years after the pulse emission.

[1)] In quantifying these radiative effects, climate models considering chemistry and dispersion must be used. If this is not practical, then these effects can be left out of the calculation. Default values for $TOPr_{O3}$, $TOPr_{SO4}$, $TOPr_{Ni}$, k, for NOx emissions from Table A.5 can be used, but the resulting effect on the uncertainty of final RF footprint results, which will be significant, should be considered.

**Table A.1. Default parameters for quantifying μRF for $CO_2$ in Equation A.3.**
*See Equation 8.SM.10 and Table 8.SM.10 in IPCC AR5 Working Group 1, Chapter 8 Supplemental Material for reference.*

| | 1st term | 2nd term | 3rd term | 4th term |
|---|---|---|---|---|
| Unitless exponential coefficient ($a_i$) | $a_0$ = 0.2173 | $A_1$ = 0.2240 | $A_2$ = 0.2824 | $a_3$ = 0.2763 |
| Time scale ($\tau_i$) in years | Not applicable | $\tau_1$ = 394.4 | $\tau_2$ = 36.54 | $\tau_3$ = 4.304 |

**Table A.2. Default Radiative Efficiencies (RE) and Average Atmospheric lifetimes for GHGs**
*These radiative efficiency values can be used for projections up to 10 years in the future; for longer term projections, they should be updated to account for time-varying changes in RE.*

| GHG | RE, mW/(m² Tg) | Average Atmospheric Lifetime τ | Data Source |
|---|---|---|---|
| Methane ($CH_4$) | 0.27 | 12.4 years | Shindell et al. 2009 |
| Nitrous Oxide ($N_2O$) | 0.385 | 121 years | IPCC AR5 Table 8.A.1. and calculation |
| Sulfur Hexafluoride ($SF_6$) | 22.0 | 3200 years | IPCC AR5 Table 8.A.1. and calculation |
| HFC-134a | 8.85 | 13.4 years | IPCC AR5 Table 8.A.1. and calculation |
| Nitrogen Trifluoride ($NF_3$) | 15.9 | 500 years | IPCC AR5 Table 8.A.1. and calculation |

**Table A.3. Default Radiative Efficiencies (RE) for sulfur dioxide emitted in four different regions**

| Forcer | RE, mW/(m² Tg) [1] | Data Source |
|---|---|---|
| Sulfur Dioxide ($SO_2$) from East Asia | -5.1 | Collins 2013 and Shindell 2009 |
| $SO_2$ from Europe | -6.8 | Collins 2013 and Shindell 2009 |
| $SO_2$ from North America | -6.8 | Collins 2013 and Shindell 2009 |
| $SO_2$ from South Asia | -6.8 | Collins 2013 and Shindell 2009 |

***NOTE 1*** *RE values in this table are from Table 1 of W.J. Collins et al. 2013, taken as identical to the AGWP-20 values (the Absolute Global Warming Potential, or AGWP, is the same over any time horizon for short-lived climate forcers, and the RE over one year is the same as the AGWP over a one year time horizon), but increased by 75% to account for the indirect effect of sulfate aerosols on clouds (the calculation approach used by Shindell 2009 to estimate the indirect effect on clouds).*

**Table A.4. Black carbon and organic carbon radiative default efficiency values, for different regions and source types. Includes both the direct and indirect effect from deposition on ice and snow.**
*Calculated using Table 1 of Bond 2011*

| | Black carbon RE, mW/(m² Tg) | Organic Carbon RE, mW/(m² Tg) |
|---|---|---|
| Global average | 71.6 | -3.98 |
| Energy-related sources | | |
| Average energy | 69.1 | -2.61 |
| Canada | 74.1 | -1.31 |
| USA | 62.9 | -1.93 |
| Central America | 74.1 | -3.30 |
| South America | 75.9 | -3.05 |
| Northern Africa | 82.8 | -3.61 |

| | | |
|---|---|---|
| Western Africa | 77.2 | -3.86 |
| Eastern Africa | 72.8 | -4.23 |
| Southern Africa | 78.4 | -4.86 |
| OECD Europe | 60.4 | -1.99 |
| Eastern Europe | 65.4 | -2.30 |
| Former USSER | 84.0 | -1.87 |
| Middle East | 84.7 | -3.61 |
| South Asia | 88.4 | -5.04 |
| East Asia | 63.5 | -1.62 |
| Southeast Asia | 61.0 | -2.80 |
| Oceania | 64.1 | -3.49 |
| Japan | 49.2 | -0.87 |
| Open burning-related emissions | | |
| Average open burning | 76.6 | -4.61 |
| Europe | 89.0 | -4.48 |
| Northern Asia | 128.2 | -3.55 |
| Southern Asia | 90.3 | -5.98 |
| North America | 117.7 | -3.55 |
| S/C America | 85.9 | -5.73 |
| Africa | 56.0 | -3.80 |
| *NOTE: Black carbon and organic carbon specific forcing pulse values were converted to GWP-20 values by dividing by 4 x $10^{-4}$ and then to AGWP-20 by multiplying with AGWP-20 of $CO_2$. As the AGWP-20 is identical to AGWP-1 for black carbon, this value was taken as the annual average radiative efficiency. [Bond, T., et al. 2011.] Value is based on the highest SFP value for black carbon.* | | |

**Table A.5. Radiative efficiency and k values for different effects of NOx that can be used as a default.**
*[Columns $TOPr_{O3}$ and K from Fry, M. M. et al, 2012; Column $TOPr_{Ni}$ from Collins, W.J. et al, 2013]*

| | **$TOPr_{O3}$ [1)]** | **$TOPr_{SO42-}$ [1)]** | **$TOPr_{NO3-}$ [2)]** | ***k*** **[3)]** |
|---|---|---|---|---|
| East Asia | 2.47 | 0.16 | -2.0 | -0.87 |
| European Union | 0.93 | -0.37 | -2.0 | -0.56 |
| North America | 2.42 | 0.14 | -2.0 | -0.93 |
| South Asia | 4.28 | -0.48 | -2.0 | -1.71 |
| **Averaged 4 regions** | **2.14** | **-0.08** | **-2.0** | **-0.87** |

*[1] $TOPr_{SO42-}$ and $TOPr_{O3}$ respectively characterize the effect of a NOX emission on the destruction or enhancement of sulfate aerosols and tropospheric ozone formation. To calculate these parameter values in the table, the 20-year AGWPs calculated from Table S2 (using the standard conversion of AGWP to GWP) of the Supplemental Material for Fry, M.M et al, 2012 was taken for these specific effects. The effects are short-lived and therefore the 20-year AGWP is the same as 1-year AGWP values, which are equivalent to the average one year for the radiative efficiency of methane's effect on these pollutants. Therefore, these values are numerically equivalent to the 20-year AGWP reported in Table S2 of Fry, M.M. et al, 2012.*

*[2] $TOPr_{Ni}$ is taken as -2.0 x $10^{-12}$ W $m^{-2}$ $kg^{-1}$, using data reported in Collins, W.J. et al, 2013. ("We can use the results of Bauer et al (2007) who calculated a normalized direct RF from global anthropogenic NOx emissions of -2.0 x $10^{-12}$ W $m^{-2}$ $kg^{-1}$.")*

*[3] These k values are calculated from Table S2 of Fry, et al, 2012, by dividing the AGWP-20 of methane with the calculated AGWP-20 of the NOx methane effect in this table. These k values correspond approximately to the kilograms of methane destroyed by each kilogram of emitted NOx. [Fry, M.M. et al, 2012.] See table below for examples.*

| | AGWP-20, methane, calculated using Equation A.4. | AGWP-20, methane effect, Table S2 | K, unitless |
|---|---|---|---|
| East Asia | 2.55 | -2.21 | -0.87 |
| European Union | 2.55 | -1.42 | -0.56 |
| North America | 2.55 | -2.36 | -0.93 |
| South Asia | 2.55 | -4.35 | -1.71 |
| 4 regions | 2.55 | -2.22 | -0.87 |

Direct effects on surface reflectivity shall be considered – i.e., changes in the albedo resulting from land use changes, reflectivity of clouds (Equation A.7). Indirect effects on surface reflectivity shall be quantified or estimated, provided they are expected to have a material effect on net RF results. If indirect effects would lead to an increase in RF, they shall be quantified to understand the total net RF change induced by the activity.

**Equation A.7. Calculating the RF from a change in albedo between $t_F$ and an earlier time $t_0$ (included in $RF_{non\text{-}emission\ CF}$):**[1),2)]

$$RF_{albedo\ change}(t_F, t_0) = -RF_{TOA} \times \mathcal{F}_a \times (\alpha_F - \alpha_0) \times \frac{A_{alb}}{A_{Ea}}$$

Where :

- $t_f$ is the year in which RF is being calculated
- $t_0$ is the first year in the analysis timeframe
- $RF_{TOA}$ is the downward solar radiation at the top of the atmosphere
- $\mathcal{F}_a$ is an atmospheric transmittance factor expressing the fraction of the radiation reflected from the surface that reaches the t top of the atmosphere
- $(\alpha_F - \alpha_0)$ is the change in surface albedo from $t_0$ to $t_F$
- $A_{alb}$ is the albedo changed area
- $A_{Ea}$ is the surface area of the Earth (510 million km²)

*1) In addition to albedo, $RF_{non\text{-}emission\ CF}$ may include factors such as thermal pollution and loss of evaporative cooling.*

*2) Equation Source: Lenton TM, Vaughan NE (2009). "The radiative forcing potential of different climate geoengineering options." Atmos Chem Phys 9:5539–5561*

### A.4. Equivalency in Metrics

Direct and indirect changes to RF resulting from increased emittance of lower frequency radiation (i.e., Earth radiation) are considered if they are material. Note the equivalency of the following three types of metrics (Table A.6).

**Table A.6. Equivalent metrics to express the heat absorbed across the total surface area of the Earth (510 million square kilometers).**

| Radiative Forcing measured in W/m² | Radiative Forcing Measured in t $CO_2$fe | Total Heat Rate Level Increase Measured in TW |
|---|---|---|
| 1 W/m² | 564 x $10^9$ | 510 TW (i.e., trillion Watts) |
| 2 W/m² | 1,128 x $10^9$ | 1,020 TW (i.e., trillion Watts) |
| 3 W/m² | 1,692 x $10^9$ | 1,530 TW (i.e., trillion Watts) |

### A.5. Feedback Loops

Effects on known feedback loops on RF shall be considered if they have a material effect.

### A.6. Regional Impacts

To determine the regional impacts of a given climate forcers, regional dispersion and atmospheric chemistry modeling may be used for more precise results.

### A.7. Uncertainty and Data Quality Considerations

Different kinds of uncertainty and data quality shall be considered when quantifying RF, such as:

- Atmospheric lifetimes of different species
- Radiative properties of different species
- Net RF from emissions of organic carbon from its short-wave/UV absorption (i.e., from brown carbon absorption).
- Uncertainty in quantifying biogenic emissions of $N_2O$ and methane from agricultural systems
- Uncertainty in quantifying biogenic carbon uptake and retention from land-based projects/organizational activities (e.g., forestry, biofuels)
- Uncertainty in ocean and land carbon absorption
- Black carbon direct RF absorption
- $NO_x$ conversion rates to tropospheric ozone, nitrate aerosols
- Indirect RF effects of ozone precursors – tropospheric ozone effect on methane, effects on carbon uptake by plants
- Magnitude of effect of methane on tropospheric ozone
- Effects of local meteorological conditions
- Effects of aerosol-cloud interactions
- Greenhouse gas concentration effect on RF
- Aerosol-cloud interactions (affecting aerosol and precursor emissions)
- Variations in well-mixed GHG Radiative Efficiency due to uncertain projections of well-mixed GHG concentration
- Differences in the way the longwave and shortwave radiative forcing impact the atmosphere and surface
- Aggregation of RF across different forcers or time periods
- Future scenario information, in particular at smaller spatial scales or project level
- Historical emissions in the quantification RF
- Carbon cycle feedback loops
- Climate feedback

### A.8. Data Collection

***Types of data***

Project Proponents and project implementers should collect site-specific data for project activities under their financial or operational control ,as well as for activities beyond direct financial or operational control that contribute a significant percentage to the baseline and project scenarios.

***NOTE:*** *Site-specific data refer to either direct climate forcer emissions (determined through direct monitoring, stoichiometry, mass balance, or similar methods), activity data (inputs and outputs of processes that result in climate forcer emissions or removals) or emission factors.*

- Data should be representative of the processes for which they are collected.
- Primary data that are not site-specific should be used when the collection of site-specific data is not practicable.
- Secondary data should only be used for inputs and outputs when the collection of primary data is not practicable, or for processes of minor importance. Secondary data should be justified and documented.
- The best quality data should be sought to reduce bias and uncertainty. Data quality should be characterized by both quantitative and qualitative aspects.

While well-mixed GHG emissions have well-characterized RF levels, the RF levels of non-well-mixed climate forcers (NWMCFs) can be highly variable on a regional and global level, as well as in time. For each non-well mixed climate forcer, spatial and temporal characterizations (which can include underlying surface albedo, cloud cover, dispersion, and atmospheric lifetime data) should be considered in the data quality analyses.

***Specific Data Collection Guidance for Selected Climate Forcers***

Guidance for data collection for selected climate forcers is provided. Data collection for GHGs and other climate forcers follow widely established procedures.

- **Black carbon and other carbonaceous aerosol emissions**
  For black carbon and other carbonaceous aerosols, the radiative efficiency and atmospheric lifetime used to quantify RF from these emissions is specific to the region of the emission. The source types, seasonality, and number of emission sources vary dramatically region-to-region for black carbon emissions. As a result, black carbon radiative efficiency values and atmospheric lifetimes used to quantify RF differ between regions. Sectors within each region will have different data collection and quantification needs.

- **Radiative forcing from albedo change**
  Radiative forcing from albedo change shall be quantified by considering the intensity of incoming radiation, atmospheric transmittance and the change in albedo. The intensity of incoming radiation can be retrieved from various atmospheric databases (e.g., NASA) or numerical simulation models such as weather and forecasting models. The annual global mean value of atmospheric transmittance, which is 0.730, can be considered for the calculation of surface albedo-induced RF. This transmittance should be adjusted to account for the cloudiness of different areas (surface albedo changes having a lesser effect in regions with relatively more clouds).

***Specific Data Collection Guidance for Large Geographic Regions***

- **$CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, $SF_6$, $NF_3$, $SF_5CF_3$, halogenated ethers, other halocarbons reported under UNFCCC**

Data collection and reporting for national organizations is consistent with the UNFCCC reporting requirements for national GHG inventories.[2]

- **Black carbon**
  The RF resulting from black carbon shall first be evaluated with modeled emissions inventories calculated by multiplying measures of activity (e.g., liters of diesel fuel consumed) with emissions factors (e.g., grams black carbon per liter diesel fuel combusted). These modeled emissions inventories shall be based upon well-documented activity levels and publicly reported emissions factors that account for local conditions, including combustion type, seasonality and other considerations affecting the amount of black carbon emitted. However, because modeled emissions inventories for black carbon usually significantly understate emissions, the modeled emissions data should be adjusted to be consistent with satellite-based emissions assessments, if available, which are often more accurate and more complete. The method used in Bond *et al* 2013 should be the basis of this adjustment, whereby adjustment factors are used to scale the black carbon emissions to their appropriate level. To the extent possible, black carbon emission estimates shall be generated using multiple methods and data sources, then compared in a sensitivity analysis to help assure robustness. The approach for quantifying black carbon emissions used in the RF inventory and RF footprint should be described.

- **Tropospheric ozone**
  Emissions inventories for NOx (a tropospheric ozone precursor) shall be quantified using methods that are consistent with country criteria air pollutant programs (e.g., in the U.S., the Environmental Protection Agency tracks NOx emissions in the National Emissions Inventory). To the extent possible, emissions inventories for NOx emissions shall also be calculated using empirical satellite measurements of column concentrations of $NO_2$, $O_3$, $HNO_3$, and CO (see Miyazaki 2016 for an example).[3] Satellite-based emissions estimates are compared with existing emissions inventories. The approach for quantifying NOx emissions used in the RF inventory and RF footprint should be described if NOx RF is included.

- **$SO_2$ emissions**
  $SO_2$ emissions shall be tracked in the key sectors of coal-fired power generation, fuel combustion used to operate vehicles and equipment (especially diesel vehicles), refineries, and metallurgical facilities using coking coal. $SO_2$ emissions in these sectors shall be quantified based on emissions inventories. The total national emissions shall be compared to satellite data regarding $SO_2$ concentrations over the country. Adjustments to the emission inventory for $SO_2$ should be made if a major discrepancy between the satellite data and emissions inventory exists. Adjustments could take the form of multiplying the $SO_2$ emissions inventory by a factor which represents the ratio of regional $SO_2$ emissions derived from satellite-based data to emissions inventory-based data, or other approaches.

- **CO and VOCs**

[2] For example, https://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf
[3] Miyazaki et al., "Decadal changes in global surface NOx emissions from multi-constituent satellite data assimilation", *Atmos. Chem. Phys.*, 17, 807–837, 2017)

For carbon monoxide and VOCs, emissions shall be based upon existing country-level inventories. Historical emissions shall be tracked to the extent that the radiative influence has a measurable effect on the RF inventory and RF footprint.

**Emissions data collection time period**

The source of inventory data (e.g., activity-based versus satellite-based emissions data) can potentially have a large impact on results. As such, data sources should be selected that are comparable over the analysis timeframe so that changes in emissions reflect changes in the system under study rather than differences in data sourcing methods or modelling parameters. The sources of inventory data should be documented.

## Appendix B: Free, Prior and Informed Consent[4]

Where such stakeholders have been identified under 5.10,:

- The Project Proponent shall have a published policy declaring its respect for the rights of indigenous peoples and the interests of indigenous sovereign nations, its recognition of the historical, traditional, and religious significance of the land on which its operations take place, and its recognition of the fauna and flora inhabiting this land.
- The Project Proponent shall communicate this policy to indigenous peoples potentially affected by its activities and shall document its conformance with this policy on an ongoing basis.
- The Project Proponent shall confirm that its operation is located in an area in which the applicable governmental jurisdiction has consulted with indigenous peoples (if any such communities are present in the region) and has gained Free Prior Informed Consent (FPIC) to project operations and provide documentation thereof. If governmental consultation has not occurred and consent has not been obtained, the Project Proponent shall provide written evidence of its own actions taken to consult with the indigenous community.
- For any new operation, the entity shall seek FPIC during the planning stages from indigenous peoples if their rights or interests could be affected, and ensure that no new operation begins unless such consent is granted (where applicable), on the basis of a mutually agreed upon decision-making process for obtaining consent that is democratic across the community.
- The Project Proponent shall notify indigenous peoples if changes to operations related activities have the potential to impact their rights or interests.
- The Project Proponent shall collaborate with indigenous peoples' representatives in monitoring of the implementation of FPIC agreements.
- The Project Proponent shall document the FPIC process and publicly report its results.
- The Project Proponent shall undertake steps to ensure meaningful communications and ongoing engagement with indigenous peoples, as might be applicable and to the extent practicable.

*Note: See, for instance the UN Declaration of the Rights of Indigenous Peoples and the ILO C169.*



[4] Per the United Nations "FPIC is a principle protected by international human rights standards that state, 'all peoples have the right to self-determination' and – linked to the right to self-determination – 'all peoples have the right to freely pursue their economic, social and cultural development'. Backing FPIC are the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), the Convention on Biological Diversity and the International Labour Organization Convention 169, which are the most powerful and comprehensive international instruments that recognize the plights of Indigenous Peoples and defend their rights."




Version 2.0 (August 2025)