INTERNATIONAL FOUNDATION FOR VALUING IMPACTS

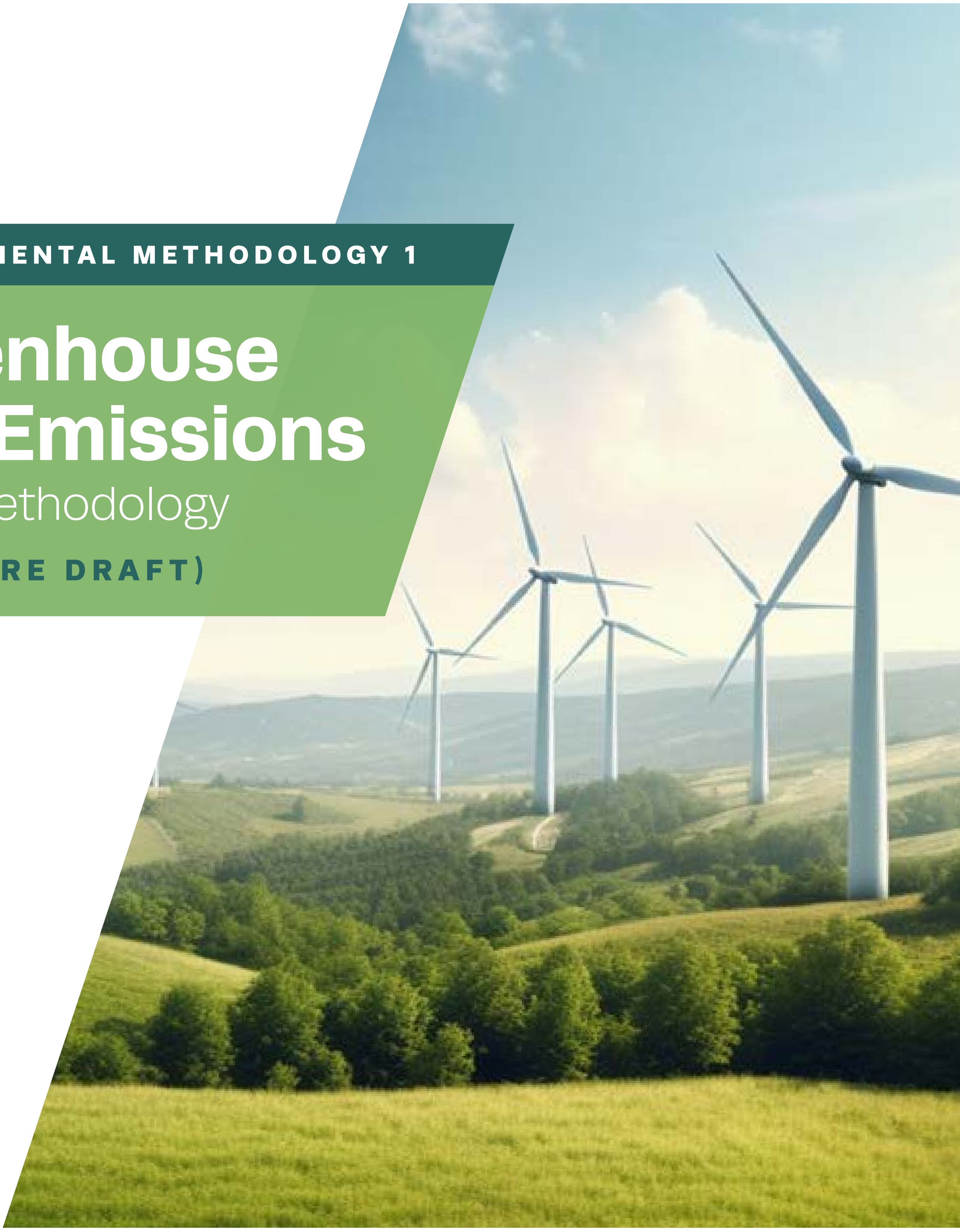
value balancing alliance

ENVIRONMENTAL METHODOLOGY 1

Greenhouse Gas Emissions

Topic Methodology

(EXPOSURE DRAFT)



COMMENTS TO BE RECEIVED BY **APRIL 30, 2024**

The International Foundation for Valuing Impacts, Inc. (IFVI) is a section 501(c)(3) public charity dedicated to building and scaling the practice of impact accounting to promote decision- making based on risk, return, and impact.

The Value Balancing Alliance (VBA) is an independent and not-for-profit member association organized under German law founded with the ambition of changing the way company performance is measured and valued so as to enable decision makers to act consciously.

This Exposure Draft has been produced by the International Foundation for Valuing Impacts (IFVI) in partnership with the Value Balancing Alliance (VBA) as part of the impact account system (the Methodology). The Methodology is a **globally applicable** and **comprehensive open-source** methodology for valuing organizational social and environmental impact that is designed for incorporation into financial analysis and organizational planning and decision-making.

The Methodology is governed by the Valuation Technical & Practitioner Committee (VTPC), an independent committee comprising 18 members, established by IFVI and authorized by its Terms of Reference to direct, validate, and approve impact accounting research and methodology produced by the cooperation of the IFVI and VBA.

VTPC members are global leaders in the fields of impact, sustainability, accounting, business, and finance. Members provide advice in their individual capacities as experts, with composition and procedures designed to ensure independence, balance, and the avoidance of conflicts of interest. Please refer to the full Terms of Reference for information regarding membership, voting, and approval processes.

Methodology development aims to follow a rigorous and credible due process balanced with the urgent and dynamic needs of stakeholders in the face of great social and environmental challenges. The development process is outlined in the Due Process Protocol and designed to be impact-focused, stakeholder-informed, collaborative, and transparent. As detailed in the Due Process Protocol, formal methodology statements undergo public exposure prior to final approval by the VTPC.

The IFVI Board of Directors provides oversight to the Due Process Protocol through its Due Process Oversight Committee. More information about the VTPC and Due Process Protocol are available in the VTPC Terms of

Questions or comments about IFVI governance or methodology can be submitted to the VTPC at VTPCLeadership@ifvi.org, the Chair of the DPOC at DueProcessOversight@ifvi.org, or directly to Technical Staff at research@ifvi.org.

Comments should be sent to the technical staff via e-mail at research@ifvi.org.
Please include “GHG Emissions Public Comment” in the subject line.

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Explanatory Note

BACKGROUND

This document, the Exposure Draft for the *Greenhouse Gas Emissions Topic Methodology* (GHG Exposure Draft), develops an impact pathway that causally links GHG emissions with outcomes and impacts that affect the well-being of people through changes in the condition of the natural environment.

The purpose of the GHG Methodology is to guide preparers of impact accounts through the process of measuring and valuing the impact of GHG emissions. This provides users of impact information such as managers of entities, investors, or affected stakeholders with methods to manage the sustainability-related risks, opportunities, and impacts of an entity. The GHG Methodology aids decision-making regarding an entity's contribution to sustainability. It is one of a series of Topic Methodologies to be developed as part of the impact accounting system for a comprehensive assessment of material value created and destroyed by an entity.

The GHG Exposure Draft was developed by the technical staff of the International Foundation for Valuing Impacts (IFVI) and the Value Balancing Alliance (VBA) beginning in June 2023. The development process involved a comprehensive GHG impact valuation literature review, including methods developed previously by the Impact Weighted Accounts Initiative and VBA. Subsequent research sought alignment with established protocols, frameworks, and disclosure requirements by relevant standard setters. Throughout the process, the technical staff regularly sought expert consultation from various entities to better understand key technical aspects and to build strong relationships with peers in the ecosystem.

The GHG Methodology is intended to augment and build on the foundational work of other protocols and sustainability standard setters. The GHG Methodology includes Scope 1, 2, and 3 emissions reporting, aligning with the GHG Protocol, European Sustainability Reporting Standards (ESRS) E1: Climate Change, International Financial Reporting Standards (IFRS) S2: Climate-related Disclosures, and Global Reporting Initiative (GRI) 305: Emissions 2016. Ideas and definitions also build on work by the Climate Impact Lab, Capitals Coalition, Impact Management Platform (IMP), Intergovernmental Panel on Climate Change (IPCC), Resources for the Future, Transparent Project, United Nations Framework Convention on Climate Change (UNFCCC), and the World Resources Institute (WRI). The intentional alignment with these leading organizations and initiatives is meant to build consensus on and advance GHG emissions impact measurement and valuation.

The development of the GHG Exposure Draft included engagement with the Valuation Technical and Practitioner Committee (VTPC) members. A small group of VTPC members were convened for two sessions in October and November 2023. The purpose of these meetings was to provide guidance on a variety of issues that were integral in the development of the GHG Exposure Draft. Following the second small group session, a complete version of the GHG Exposure Draft was shared with the full VTPC for comment and review in advance of the December 2023 VTPC meeting.

DUE PROCESS PROVISIONS APPLICABLE TO THE EXPOSURE DRAFT

The Due Process Protocol of IFVI establishes an independent committee, the Valuation Technical and Practitioner Committee (VTPC), to direct, validate, and approve impact accounting methodology produced by the partnership between IFVI and VBA. The VTPC oversees and is supported by the work of the technical staff of IFVI and VBA.

Public exposure is a vital step in the Due Process Protocol to ensure the development of high-quality methodologies that reflect stakeholder input. When the VTPC has reached general agreement on a methodology statement, the VTPC votes on whether to proceed with releasing a proposed methodology statement. An approval by a simple majority of the VTPC is required to proceed with releasing an exposure draft of a proposed statement.

The Exposure Draft herein reflects feedback provided by members of the VTPC and is a proposal of a statement that has been approved for public exposure.

After the conclusion of the public comment period, the VTPC reviews the received comment letters. To support the VTPC's considerations, the technical staff will prepare a summary of the comment letters. The summary provides an overview of the significant issues raised in the letters and any additional related research and/or consultations. Comments are published on the IFVI website and significant matters are deliberated at a VTPC meeting.

Per the Due Process Protocol, after review and deliberation of the received comments, the VTPC will make a determination to:

a. Proceed with a vote to approve the methodology as proposed in the exposure draft;

b. Evaluate and proceed with a vote on a revised methodology with limited modifications based on public input and/or piloting; or

c. Direct technical staff to conduct additional research and consultation on issues raised through public comments and/or piloting.

The VTPC may determine that an additional public comment period may be appropriate if the extent of modifications and evidence considered is fundamentally different compared to the proposed methodology in the exposure draft. In some circumstances, the VTPC may consider removing a project from the work plan based on its deliberations.

Upon an affirmative majority vote by the VTPC to issue a methodology statement, the statement will be made available to the public on the IFVI and VBA websites in a timely fashion. The issued statement will be accompanied with a published basis for conclusions containing a rationale for the statement, summary of research and consultation, and other supporting information as determined by the VTPC.

Technical staff may make editorial corrections to issued methodologies to remedy spelling errors, grammatical mistakes, or other drafting errors that do not alter the technical meaning of the statement.

For more information, see the Due Process Protocol.

Exposure Draft Summary

The following is a section-by-section summary of key proposals made in the GHG Exposure Draft and is not an exhaustive overview of the statement. A summary is included to highlight decisions made during the drafting of the Exposure Draft and the basis for those conclusions.

SECTION 1: INTRODUCTION

This section lays out the purpose of the GHG Methodology (Section 1.1), provides a high-level description of the topic and its impacts (Section 1.2), introduces key concepts and definitions (Section 1.3), and defines the scope of what is and is not included within the Topic Methodology (Section 1.4).

Section 1.1 defines the purpose of the GHG Methodology to provide impact information by measuring and valuing impacts of corporate entities in monetary terms. This section also stresses that the GHG Methodology should be followed to the fullest extent possible and, by doing so, allows entities to assess whether GHG emissions are a material impact.

Section 1.2 defines GHG emissions and the significant impacts they have on society. The affected stakeholder for GHG emissions is all of society as GHG emissions anywhere lead to impacts everywhere. This societal lens is further evidenced by the significant organization and global response to reduce GHG emissions that has already begun.

In Section 1.3, five terms are defined to provide preparers guidance when developing GHG impact accounts. These definitions are largely based on those developed by the United Nations Framework Convention on Climate Change (UN FCCC), the Intergovernmental Panel on Climate Change (IPCC), the GHG Protocol, and the social cost of carbon (SCC). This is the first section to lay out the social cost of carbon as the approach used to develop the value factor used in GHG impact valuation. As a part of this approach, it also defines discounting as an important conceptual term for understanding how to value impacts from GHG emissions that happen in the future. See Appendix A: Glossary for complete definitions.

Finally, section 1.4 provides critical guidance about what is and is not included within the boundaries of the GHG Methodology. Included are all gases as defined by the GHG Protocol that are emitted along the full value chain of an entity. The GHG Exposure Draft intentionally defines full value chain emissions and the process of attribution but also acknowledges that Scope 3 emissions may be modeled due to the lack of complete data at present. Critically, carbon offsets (developed or purchased), renewable energy certificates (RECs), and avoided emissions are not included within the scope of the GHG Methodology. While all of these are important part of the GHG measurement and management landscape, they were not included to allow for clearer application of the GHG Methodology and to clearly delineate the impacts associated with GHG emissions. Future work plans may develop approaches to address each of these.

SECTION 2: IMPACT PATHWAY

As laid out in General Methodology 1, the impact pathway serves as the framework for measuring impacts and defines the causal relationship between an entity's activities and changes in the well-being of people. Section 2 of the GHG Exposure Draft lays out the impact pathway in both visual (Figure 2) and descriptive (Section 2.2) form. Both forms are structured to delineate inputs, outputs, outcomes, and impacts as well as the linkages between each.

For the topic of GHG emissions, the inputs to the entity are fossil fuel-derived energy and resources. These inputs lead to the output of GHGs (outputs) that occur at various locations across the value chain. The accumulation of GHGs has and will continue to lead to an altered condition of the environment (outcomes) that each have monetized impacts on the well-being of people.

In addition to laying out the impact pathway, this section highlights several aspects of the impact pathway that should aid preparers in the application of the GHG Methodology. For outputs, Figure 2 visualizes that GHG emissions impact accounts should be considered across 4 categories: Scope 1, Scope 2, Scope 3 upstream, and Scope 3 downstream emissions. Figure 2 demonstrates that impact valuation using the GHG Methodology is the combination of an entity's emissions and a value factor that considers the outcomes and impacts. Finally, Figure 2 and section 2.2 demonstrates numerous impacts from GHG emissions while acknowledging that many impacts are not yet monetized even in the best available current models used to develop the value factor.

SECTION 3: IMPACT DRIVER MEASUREMENTS

This section focuses on the impact driver information needed from an entity to develop GHG emissions impact accounts. In addition to guiding preparers through data requirements (section 3.1), the section also delineates how these data align with reporting standards (section 3.2) and how to address data sources, gaps, and uncertainty (section 3.3).

The data requirements to develop GHG emissions impact accounts are designed to minimize discrepancies with other guidance or reporting that entities are already using. Therefore, the data requirements align closely with the GHG Protocol in the inclusion of Scope 1, 2, and 3 emissions and the conversion of all GHGs to metric tons of CO_2 equivalents (CO_2e). The section also reinforces that while many aspects of impact accounts are quantitative, significant notes and qualitative commentary should be included such as approaches to handling data gaps, key assumptions, progress towards rigorous targets, and adherence to planetary boundaries and thresholds.

Section 3.2 points the preparer to important alignment considerations with reporting requirements from the European Sustainability Reporting Standards E1: Climate Change, the International Financial Reporting Standards S2: Climate-related Disclosures, and the Global Reporting Initiative 305: Emissions 2016. The specific text from each standard setter that requires Scope 1, 2, and 3 emissions and the use of metric tons of CO_2e is stated. This alignment is highlighted in the text and concisely organized in Table 1.

Because some data, particularly Scope 3 emissions, are likely to be missing or estimated using proxy data, section 3.3 guides preparers through addressing data gaps and uncertainty. First and foremost, the priority should be for GHG emission impact accounts to faithfully represent the full value chain operations even if barriers exist. To address potential barriers, this section defines the types of data that should be prioritized, how to evaluate high-quality data sources, and asks for preparers to report qualitative uncertainty and, if possible, quantitative uncertainty. Much of the guidance of this section also builds on the foundational Scope 3 guidance of the GHG Protocol.

SECTION 4: OUTCOMES, IMPACTS, AND VALUATION

This section provides the specific formulas (section 4.1), value factor (section 4.2), and guidance criteria for updating the GHG value factor in the future.

The valuation formula is used to determine the monetary cost of GHG emissions using equations 1 – 5. These equations involve a basic multiplication of the full scope GHG emissions described in section 3 by the value factor. The GHG Exposure Draft also provides guidance for calculating GHG impact separated as Scope 1, Scope 2, Scope 3 upstream, and Scope 3 downstream to increase transparency, comparability, and decision-usefulness. Considering these separately allows preparers and users to better understand where their GHG emission impacts fall along the value chain and leads to more strategic decisions about emissions reductions.

The value factor applied in the GHG Methodology is $236 per metric ton CO_2e for GHG emissions that occurred in 2023. This value represents the average of two state-of-the-art social cost of carbon models: the Greenhouse Gas Impact Value Estimator (GIVE) and the Data-driven Spatial Climate Impact Model (DSCIM). The GHG Methodology outlines the rigorous development of both models in the primary text as well as in Appendix B: Methodological Details. One important consideration of these is the approach to discounting future climate change damages. The model applies a dynamic discount rate (Ramsey formula) that meets a near-term target discount rate of 2%. While this discount rate is lower than ones in use by some entities, it represents the best recommendation by numerous researchers and governments and is already being implemented by many pioneering organizations discounting future environmental damages.

The GHG Methodology also specifies that the value factor will increase each year and lays out four considerations that will guide those updates (Box 2). These include adjustments for inflation, updated approaches to quantifying impacts, reduced discounting as damages approach present day, and other advancements that align with principles and concepts of the General Methodology. These updates will be clearly communicated and provide any additional guidance needed to prepare impact accounts.

SECTION 5: FUTURE DEVELOPMENT

The closing section reinforces that the GHG Methodology represents the most advanced state of knowledge on GHG emission impacts while also acknowledging some limitations that are likely to be further developed in the impact accounting ecosystem. Advancements that may be considered in the future include new methods that more completely account for full scope emissions, advancements to social cost of carbon models, impact account methodologies for GHG offsets and carbon credits, and further incorporation of planetary thresholds and net-zero targets.

Request for Public Comment

INSTRUCTIONS TO COMMENT

The VTPC invites comment letters on the proposals in the Exposure Draft, particularly on the questions set out below. Feedback from stakeholders will be incorporated impartially. The VTPC is requesting comments only on matters addressed in the Exposure Draft. Comments are most helpful if they:

a. address the questions as stated;
b. specify the paragraph(s) to which they relate;
c. contain a clear rationale;
d. identify any wording in the proposals that is ambiguous in its interpretation; and
e. include alternative proposals the VTPC should consider, if applicable.

Please note that comment letters are a matter of public record and will be published on the IFVI website after the closure of the public comment period. Comments should be sent to the technical staff via e-mail at research@ifvi.org. Please include "GHG Emissions Public Comment" in the subject line.

Questions for Feedback

Question 1 – The value factor methodology based off the Social Cost of Carbon (Section 4.2 Value Factor and Appendix B: Methodological Details)

The GHG Methodology proposes a value factor for 2023 GHG emissions of $236 U.S. Dollars that is derived from two advanced models (GIVE and DSCIM) developed within the social cost of carbon (SCC) framework. The GHG Exposure Draft lays out why the SCC approach aligns with impact accounting and why the GIVE and DSCIM models were chosen in paragraphs 49 – 51.

Both GIVE and DSCIM are new, developed in 2022, and significantly increase the estimates for the cost of a single ton of CO_2e. Because of the significant advancements in their approach, the value factor is greater than various carbon prices that might have used older SCC models or other approaches to determine the carbon price. Simultaneously, the value factor proposed in the GHG Exposure Draft is still significantly less than the actual full cost of each ton of CO_2e as numerous impacts from GHG emissions still are not represented in these models.

In addition, there are also still several critical decisions that must be made to run these models that can alter the value factor. These decisions include but are not limited to choices in future GHG emission trajectories, the length of time to model climate outcomes, and the various approaches to predicting damages. How future impacts from GHG emissions are discounted to present day values is particularly important and was considered carefully in the GHG Methodology. Because of the complexity of this topic, the GHG Methodology relies on the current best understanding and guidance from the model developers and other experts.

Finally, the SCC used to determine the value factor will need to be updated regularly to adjust for inflation, incorporate updated damage estimates, reduced discounting as damages are closer to present day, and advancements to the approved models that align with the principles and concepts in General Methodology 1. This rationale is explained in paragraph 54 and Box 2.

1a. Do you agree with the approach taken in establishing the Social Cost of Carbon within the methodology, including the averaging of GIVE and DSCIM to determine the value factor? Why or why not?

1b. Do you agree with the choice of a 2% dynamic discount rate that estimates damages to the year 2300? Is the reasoning for how this discount rate was chosen rate clear enough? Why or why not?

1c. Is the description of a dynamic price that changes over time clearly presented? If not, how would you enhance the clarity of this section?

Request for Public Comment

Question 2 – Guidance on data gaps for Scope 3 emissions (Section 3.1 Data Requirements and 3.3 Data Sources, Gaps, and Uncertainty)

Scope 1, 2, and 3 GHG emissions are included within the boundaries of the GHG Exposure Draft to align with data requirements for standard setters (ESRS, IFRS, and GRI) as well as the GHG Protocol. The inclusion of Scope 3 emissions also acknowledges the large-scale importance of Scope 3 emissions and that entities have some influence and reliance on GHG emissions that occur in the value chain. The use of the GHG Methodology should strive to faithfully represent full value chain emissions.

However, the GHG Exposure Draft also acknowledges that many entities may have significant limitations in determining their full Scope 3 GHG emissions. In that regard, the GHG Exposure Draft welcomes the use of alternative approaches that utilize estimates or proxies but provides guidance on what type of approaches and data sources should be prioritized. This approach allows for broader use of the GHG Methodology particularly for entities where cost or availability limit full Scope 3 data.

The GHG Exposure Draft separates the valuation of GHG emissions impact accounts into four categories: Scope 1, Scope 2, Scope 3 upstream, and Scope 3 downstream. The total GHG emissions impact can then be considered as the sum of the four categories. This was done so that preparers and users can assess each category of GHG emissions separately which should increase transparency about where along the value chain most impacts from an entity occur.

2a. Do you think the guidance on data gaps and uncertainty for Scope 3 emissions is sufficient? If not, what should be altered?

2b. Do you agree with the separate presentation of upstream and downstream Scope 3 impacts? Why or why not?

Question 3 – Overall clarity of content and usability of the valuation formula

The GHG Exposure Draft outlines a structure that may be used as a template for future Topic Methodologies. This includes sections (1) introducing the topic, (2) describing the impact pathway, (3) defining the measurements needed to use the methodology, (4) the valuation process to determine outcomes and impacts, and (5) future considerations.

This structure centers the Topic Methodology around the impact pathway by describing the impact pathway in visual and written form immediately following the introduction of the topic. The GHG Exposure Draft then outlines Section 3 around the first steps in the impact pathway, the Impact Drivers, and Section 4 around the latter half of the impact pathway, Outcomes, Impacts, and Valuation.

Section 4: Outcomes, Impacts and Valuation also describes how to apply the GHG Methodology by laying out the equations needed for the calculations and the background used to develop the value factor. Section 4, in particular, should provide the valuation formula and value factor in a form that is clear and usable by preparers of impact accounts.

3a. Does the general framing of the GHG Topic Methodology follow a logical structure and written in a way that is clear? If not, how would you enhance the framing or clarity?

3b. Does Section 4: Outcomes, Impacts, and Valuation provide clear guidance on how to develop impact accounts on GHG emissions? If not, how would you enhance the clarity of this section?

Request for Public Comment

Question 4 – Future guidance on the impacts of GHG offset projects, purchased carbon credits, renewable energy certificates, and/or avoided emissions (Section 1.4 Scope and Assumptions, paragraphs 16 –17)

The GHG Exposure Draft focuses the scope of the methodology on actual GHG emissions from an entity and excludes other efforts that might "offset" those emissions. The most prevalent of these are credits purchased in carbon markets and renewable energy certificates for Scope 2 emissions. While each of these are important tools for mitigating the effects of climate change, they were not included in the GHG Methodology to clearly separate emission reductions from offsets in the impact accounting ecosystem.

While they are not a part of this Topic Methodology, the GHG Exposure Draft acknowledges offsets, credits, RECs, and avoided emissions as possible future topics that could advance impact accounting (paragraph 56c).

4. Do you think that future work in impact accounting should include specific guidance for GHG offset projects, purchased carbon credits, renewable energy certificates, and/or avoided emissions? If so, please describe which of these should be prioritized, how the topics may be organized, and potential approaches to valuation.

Question 5 – Additional feedback

5. Do you disagree or have concern with any additional proposal(s) in the Exposure Draft? For example, this could include feedback on the framing of the overall purpose and structure of the Methodology, references used, and definitions, among other areas. If so, what are they and what do you see as viable alternative approaches?

Executive Summary

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This Topic Methodology:

- develops an *impact pathway (Figure 1)* for the *greenhouse gas* emissions (GHG) of an entity.
- causally links the *inputs* and *outputs* of an entity with *outcomes* and *impacts* that affect the well-being of people directly or through changes in the condition of the natural environment;
- accounts for all greenhouse gases emitted in *Scope 1, 2, and 3* as defined by the GHG Protocol;
- aligns with reporting requirements in *ESRS E1: Climate Change, IFRS S2: Climate-related Disclosures, and GRI 305: Emissions 2016;* and
- does not account for *avoided emissions,* emissions reductions targets, *renewable energy certificates*, or *carbon offset projects*, whether developed within the value chain or purchased through *carbon credits.*

This Topic Methodology can be used by preparers of impact accounts to measure and value the impact of GHG emissions on people and the natural environment. The GHG Methodology can also be used by users of impact information to manage the sustainability-related risks, opportunities, and impacts of an entity and inform decision-making regarding an entity's contribution to sustainability.

To use this methodology, preparers should:

- develop a full accounting of GHG emissions including Scope 1, Scope 2, *Scope 3 Upstream*, and *Scope 3 Downstream*;
- utilize the valuation formula and value factor developed in this Topic Methodology to convert GHG emissions into impact accounts;
- present any related impact information with supplemental notes and qualitative commentary necessary to meet the qualitative characteristics of impact information[1].

The development of this methodology builds on frameworks and protocols published by leading organizations in the impact management ecosystem and sustainability-related disclosures required by governing jurisdictions and international standard setters, including:

- Climate Impact Lab;
- European Sustainability Reporting Standards (ESRS);
- GHG Protocol;
- Global Reporting Initiative (GRI);
- Intergovernmental Panel on Climate Change (IPCC);
- International Financial Reporting Standards (IFRS);
- Resources for the Future; and
- The Transparent Project.

1. See General Methodology 1: Conceptual Framework for Impact Accounting.

Executive Summary

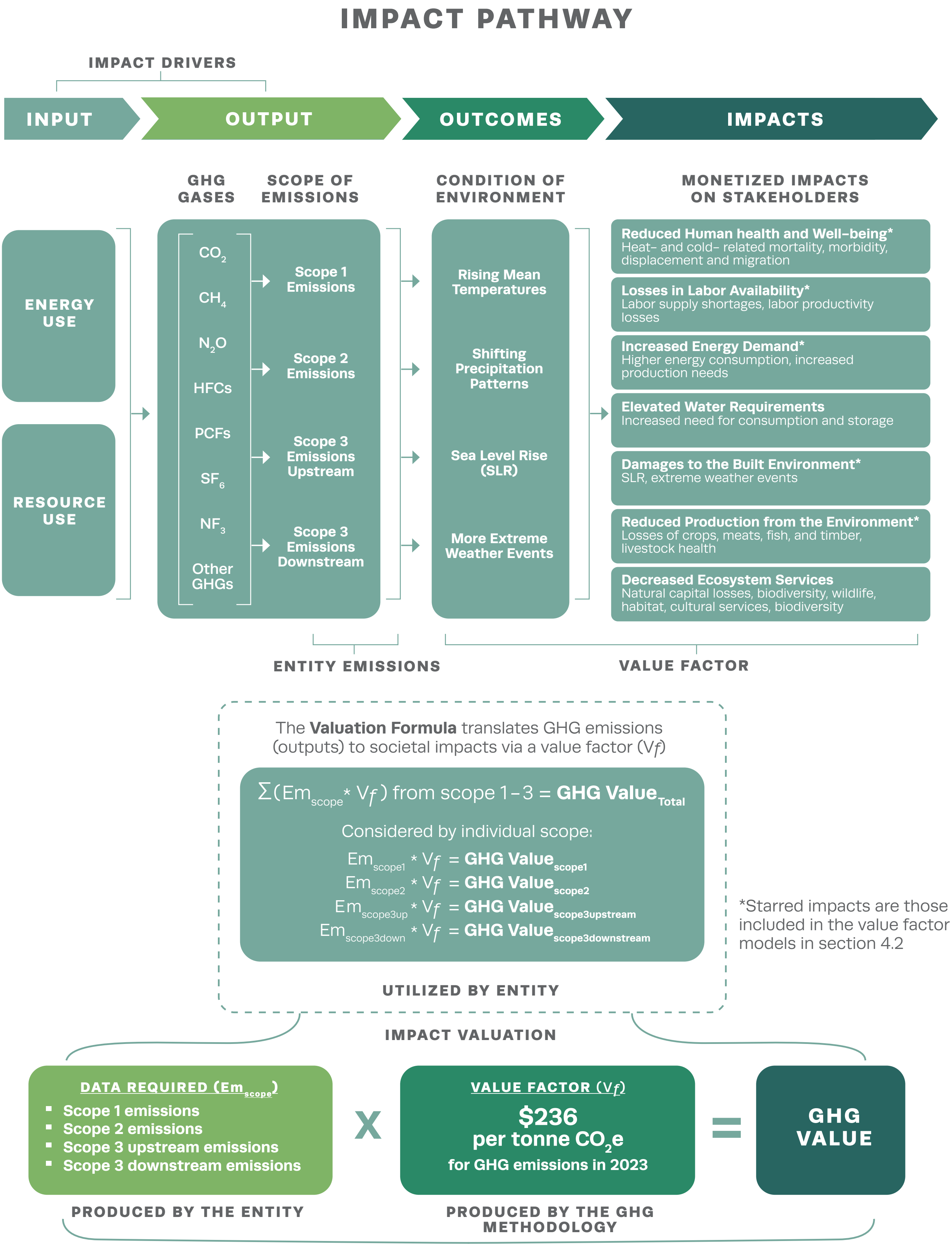

Figure 1: Impact pathway and valuation for GHG emissions

1. Introduction

1. Introduction

1.1 DOCUMENT PURPOSE

1. The purpose of this document is to outline the Topic Methodology for Greenhouse Gas emissions (henceforth, the GHG Methodology) as part of the *impact accounting* methodology being developed by the International Foundation for Valuing Impacts and the Valuing Balance Alliance.

2. The impact accounting methodology is designed to measure and value the *impacts* of corporate entities (entities or an entity) in monetary terms for the purposes of preparing impact accounts and generating impact information.

3. The GHG Methodology is further intended to be applied by preparers of impact accounts to determine whether GHG emissions are a material impact for an entity. Guidance on materiality is provided in *General Methodology 1: Conceptual Framework for Impact Accounting.*

4. Preparers of impact accounts should adhere to the GHG Methodology to the fullest extent possible and should disclose any deviations from it when shared with users of impact information.

5. The content of the GHG Methodology builds on the General Methodology and is complemented by other Topic and Industry-specific Methodologies.

1.2 TOPIC DESCRIPTION

6. For the purposes of the GHG Methodology, GHGs are components of the atmosphere that absorb and emit infrared radiation effectively trapping and emitting heat towards the surface of Earth[2].

7. Due to human-related activities, including activities from corporate entities, the concentration of CO_2 (a significant GHG) has risen to over 420 ppm, or 140 ppm above pre-industrial levels. Most of the GHG emissions have come directly from burning fossil fuels for energy or transportation as well as physical and chemical processing[3]. The increased concentration of GHGs in the atmosphere alters the *physical environment* by increasing temperatures, altering precipitation patterns, raising sea level, acidifying oceans, and intensifying the severity and frequency of extreme climate events (e.g., droughts, wildfires, hurricanes, floods)[4].

8. Each of these changes to the environment directly affects society by increasing human mortality and displacement, exacerbating outbreaks of infectious diseases, deteriorating food supplies, flooding coastal areas, and damaging infrastructure, to name a few.

9. The negative impacts on *stakeholders* from GHG emissions has impelled a significant global response to limit warming to under 1.5˚C requiring global GHG emissions to reach net-zero by 2050[5]. Achieving this target will limit and reduce catastrophic and irreversible additional impacts from GHG emissions.

10. The GHG Methodology takes a societal perspective and not of a discrete affected stakeholder group by considering the impacts on all of society. By measuring and valuing the impacts on society, GHG impact accounts can provide guidance to entities to manage and mitigate risks.

1.3 KEY CONCEPTS AND DEFINITIONS

11. For the purposes of applying the GHG Methodology, the following terms are defined as:

a. **Greenhouse Gases:** Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorinated compounds (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3)[6].

b. **Scope 1, 2, and 3 Emissions:** Categorizations of emissions, both direct and indirect, from a particular entity. See Appendix A for individual definitions of Scope 1, 2 and 3[7].

c. **CO_2 equivalents:** A metric measure used to compare the emissions of different greenhouse gases by converting them to a standardized unit based upon their *global warming potential (GWP)*[8].

2. The definition aligns with the GHG Protocol and IPCC. See definition from the United Nations Framework Convention on Climate Change in the Glossary.
3. See GHG Protocol (2004): Corporate Accounting and Reporting Standard, Chapter 4.
4. See further detail of climate change effects in IPCC (2023): Climate Change 2023 Synthesis Report
5. See the Paris Agreement (2015) to the United Nations Framework Convention on Climate Change.
6. Definition of greenhouse gases aligns with the GHG Protocol.
7. See further details of Scope emission definitions in the GHG Protocol (2004): Corporate Accounting and Reporting Standard.
8. See definition provided by UNFCCC in the Glossary.

1. Introduction

d. **Social Cost of Carbon (SCC):** The net present value of aggregate climate damages from one more metric ton of carbon in the form of carbon dioxide (CO_2), conditional on a global emissions trajectory over time[9]. The SCC is used to develop the value factor.

e. **Discounting/discount rate:** A mathematical operation that aims to make monetary (or other) amounts received or expended at different times (years) comparable across time. The discount rate is the value used to discount future monetary amounts. If the discount rate is positive, future values are given less weight than those today[10].

12. A complete set of defined terms is included in the Glossary.

1.4 SCOPE AND ASSUMPTIONS

13. The GHG Methodology includes the impacts of all GHGs as defined by the GHG Protocol and defined by the Intergovernmental Panel on Climate Change (IPCC)[11]. The accurate quantification of carbon dioxide and methane are particularly important as they represent 79% and 12% of the global GHG emissions, respectively[12].

14. Full value chain emissions fall within the scope of the GHG Methodology. This includes upstream (cradle-to-gate), *direct operations (gate-to-gate)*, and downstream (gate-to-grave) as defined in General Methodology 1[13]. An entities' own operations should be the same scope used for financial statements to ensure comparability. Scope 3 emissions may be based on model predictions and not directly measured due to the challenges of measuring *upstream* and *downstream* emissions[14].

15. The GHG Methodology recognizes full responsibility of an entity for its upstream and downstream emissions in alignment with the GHG Protocol. GHG emissions are attributed to an entity through physical or economic relationships by partitioning the inputs or outputs related to the emissions and determining the portion that is linked to the entity[15]. The inclusion of value chain GHG emissions means that double counting across entities in the same value chain will occur. However, this will not lead to double counting within an entity's impact statement.

16. Offset projects do not fall within the scope of the GHG Methodology. This includes any offset projects developed within the value chain or purchased through carbon credits. Renewable energy certificates (RECs) are also not considered within the scope of the GHG Methodology[16].

17. Avoided emissions are not included within the scope of the GHG Methodology. Avoided emissions (also sometimes referred to as *Scope 4 emissions*) are reductions to an entities' emissions that occur outside the value chain but as a result of the use of a product[17].

18. Because GHG emissions quickly mix in the atmosphere and societal impacts are global, the spatial boundary of the impacts includes the entire planet. Therefore, there are no special geographical considerations to use the GHG Methodology. Similarly, the reliance on GHGs for energy and transport is universal to nearly all business cases.

9. See definition from the International Panel on Climate Change (IPCC) in the Glossary.
10. Ibid.
11. See GHG Protocol (2004): Corporate Accounting and Reporting Standard and IPCC (2022): Climate Change 2022: Impacts, Adaptations, and Vulnerability.
12. See definition in Section 1.3 for comprehensive list of GHGs; and United States EPA (2023): Overview of Greenhouse Gases.
13. This scope is the same as the ESRS, IFRS, and GRI. In these documents, GHG emissions are categorized into Scope 1, 2, and 3 emissions as defined by the GHG Protocol.
14. See Section 3.3
15. See Greenhouse Gas Protocol (2011): Corporate Value Chain (Scope 3) Accounting and Reporting Standard, Supplement to the GHG Protocol Corporate Accounting and Reporting Standard. Note that in the GHG Protocol, the process of attribution is referred to as allocation.
16. Therefore, Scope 2 emissions accounting should take a location-based approach.
17. See World Resources Institute (2019): Estimating and Reporting the Comparative Emissions Impacts of Products.

2. Impact Pathway

2. Impact Pathway

2.1 SUMMARY

19. The impact pathway is the series of consecutive, causal relationships, ultimately starting at an input for an entity's activities and linking its actions with related changes in people's well-being. It serves as the foundation of the impact accounting methodology.

20. Detailed components of the impact pathway are outlined in subsequent sections, leading to the valuation of an entity's GHG emissions in *Section 4: Outcomes, Impacts, and Valuation.*

21. The impact pathway for GHG emissions is as follows:

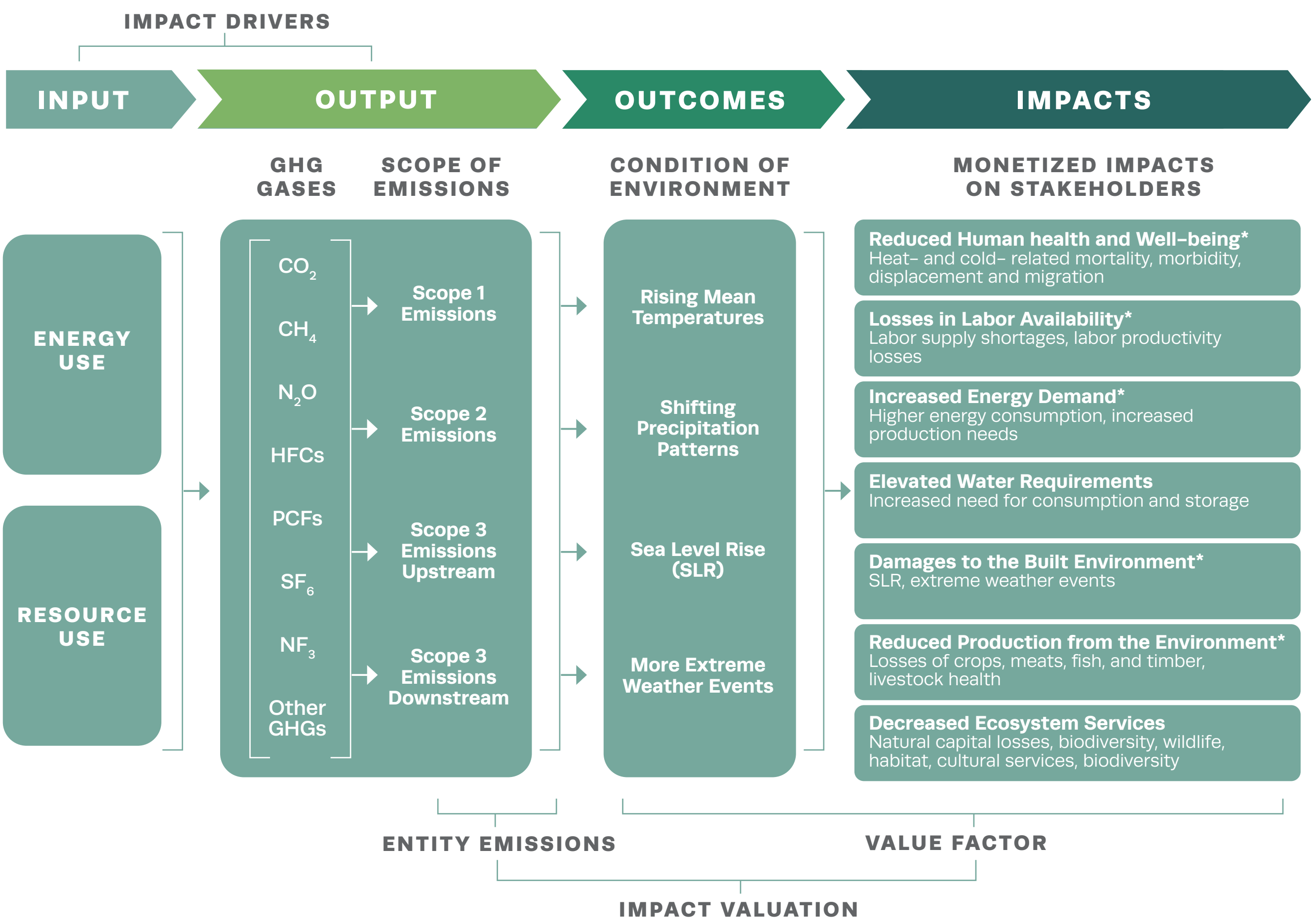

Figure 2: GHG emissions impact pathway

*Starred impacts are those included in the value factor models in section 4.2

2. Impact Pathway

2.2 DESCRIPTION AND NOTES

22. The primary inputs for the GHG emissions impact pathway are energy use and resource use. Because using fossil fuels to drive these activities are universal to numerous business activities, every entity likely has processes that lead to GHG emissions.

23. The outputs from the entity are GHG emissions. The main categories of emission sources include *stationary combustion*, *mobile combustion*, *process emissions*, and *fugitive emissions*[18]. The GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorinated compounds (PFCs), sulphur hexafluoride (SF_6), nitrogen trifluoride (NF_3), and other, less common GHGs.

24. The accumulation of GHGs in the atmosphere alters the physical environment[19]. These include rising mean temperatures, shifting precipitation patterns, sea level rise, and more extreme weather events[20]. The physical changes are also becoming more unpredictable in their frequency and magnitude adding further risks to entities, investors, and stakeholders. Every inhabited region of the planet and, therefore, every entity are affected by these outcomes.

25. Changes to the physical environment drive numerous impacts that alter the well-being of people and the condition of the natural environment. These include reduced human health and well-being, losses in labor availability, increased energy demand, elevated water requirements, damage to the built environment, reduced production from the natural environment (e.g., food and timber), and decreased *ecosystem services*[21]. This list is extensive and covers many known impacts, but is likely not exhaustive.

26. Present research has not yet captured all impacts in rigorous models. Therefore, impact accounts derived using the value factor described in section 4.2 result in an understatement of negative impacts. New research will continue to develop techniques to capture additional impacts, increasing the value factor. The impacts currently included in the value factor models in section 4.2 are starred in Figure 1[22].

18. See GHG Protocol (2004): Corporate Accounting and Reporting Standard, Chapter 6: Identifying and Calculating GHG Emissions for further guidance.
19. Outcomes are considered relative to a reference scenario where changes to the environment are evaluated relative to environmental conditions had each metric ton of GHG not been emitted.
20. For further detail see IPCC (2023): Climate Change 2023 Synthesis Report.
21. See IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability and Figure SPM.2 from IPCC (2022): Summary for Policymakers Figure SPM.2 for further detail on impacts.
22. Also see Appendix B: Methodological Details for further information about the incorporation of impacts into models that develop value factors.

3. Impact Driver Measurements

3. Impact Driver Measurements

27. *Impact drivers* reflect the data needs expected of a preparer to provide an impact account for GHG emissions. The section below outlines the specific data needed along with how these data align with various respective reporting standards.

3.1 DATA REQUIREMENTS

28. To utilize the GHG Methodology, the total GHG emissions of an entity should be measured, including Scope 1, 2, and 3. All three scopes as measured according to the GHG Protocol are fully attributable to the entity as the GHG Protocol allocates emissions to entities in a manner consistent with the requirements in the General Methodology.

29. To normalize the potential impacts of different GHGs, all GHGs should be converted to *CO_2 equivalents* (CO_2e) using Global Warming Potential (GWP). GWP values reflect the warming period over a 100-year time horizon and should come from the most recent assessment from the IPCC[23].

30. All GHG emissions data should be in units of metric tons of CO_2e.

31. To provide sufficient detail for impact accounts, emissions data should be considered in 4 distinct categories: Scope 1, Scope 2, Scope 3 Upstream, and Scope 3 Downstream[24].

32. The GHG Protocol[25] is the recommended source to guide preparers through calculating GHG emissions.

33. Supplemental notes or qualitative commentary should be included in GHG emissions impact accounts as noted in General Methodology 1. For GHG emissions this may include but is not limited to approaches to handling emissions data gaps, key assumptions, progress towards rigorous targets (e.g., Science-based Targets), and adherence to planetary boundaries and thresholds.

3.2 ALIGNMENT WITH REPORTING STANDARDS

34. The data inputs required to prepare impact accounts that measure and value GHG emissions closely align with the disclosure requirements of the European Sustainability Reporting Standards *E1: Climate Change*, the International Financial Reporting Standards *S2: Climate-related Disclosures*, and the Global Reporting Initiative *305: Emissions 2016 (Table 1).*

35. ESRS *E1: Climate Change:*

a. Disclosure Requirement E1-6 paragraph 41 states "The undertaking shall disclose its: (1) gross Scope 1 GHG emissions; (b) gross Scope 2 GHG emissions; (c) gross Scope 3 GHG emissions; and (d) total GHG emissions."
   - This statement only considers emissions and requires reporting of Scope 1, 2, and 3. This aligns with the total scope of emissions stated in *Section 3.1 Data Requirements* of this Methodology.

b. Paragraphs 45, 46, and 48 state that GHG emissions shall be reported in CO_2e using units of metric tons. This guidance aligns with *Section 3.1 Data Requirements* of this Methodology.

23. As of publication, the most recent GWP values are in the Sixth Assessment Report (AR6). IPCC (2023): Climate Change 2023: Synthesis Report.
24. Upstream Scope 3 includes categories 1-8 and Downstream Scope 3 includes categories 9-15 from the GHG Protocol (2004): Corporate Accounting and Reporting Standard.
25. This includes all resources through the GHG Protocol but of particular relevance here includes the GHG Protocol Corporate Accounting and Reporting Standard (2004), the Corporate Value Chain (Scope 3) Standard (2011), Scope 2 Guidance, and Scope 3 Calculation Guidance.

3. Impact Driver Measurements

36. IFRS S2: *Climate-related disclosures:*

a. In the section "Climate-related metrics", paragraph 29 states: "the entity shall disclose its absolute gross greenhouse gas emissions generated during the reporting period expressed as metric tons of CO_2 equivalent, classified as: (1) Scope 1 greenhouse gas emissions; (2) Scope 2 greenhouse gas emissions; and (3) Scope 3 greenhouse gas emissions".

- This statement only considers emissions and requires reporting of Scope 1, 2, and 3. This aligns with the total scope of emissions stated in *Section 3.1 Data Requirements* of this Methodology.

b. Paragraph 29 states that GHG emissions shall be reported in CO_2e using units of metric tons. This guidance aligns with *Section 3.1 Data Requirements* of this Methodology.

37. GRI *305: Emissions 2016:*

a. Disclosures 305-1 (Scope 1), 305-2 (Scope 2), and 305-3 (Scope 3) require reporting organizations to report the "gross GHG emissions" in each Scope.

- This statement only considers emissions and requires reporting of Scope 1, 2, and 3. This aligns with the total scope of emissions stated in Section *3.1 Data Requirements* of this Methodology.

b. Disclosures 305-1 (Scope 1), 305-2 (Scope 2), and 305-3 (Scope 3) state that reporting should be "in metric tons of CO_2 equivalent". This guidance aligns with *Section 3.1 Data Requirements* of this Methodology.

Data Input	Metric	ESRS E1: Climate Change	IFRS S2: Climate Related Disclosures	GRi 305: Emissions 2016
Scope 1 Emissions	metric tons of CO_2e	E1-6 Paragraph 41 (a)	Climate-related metrics paragraph 29 (a) (i) (1)	Disclosure 305-1
Scope 2 Emissions	metric tons of CO_2e	E1-6 Paragraph 41 (b)	Climate-related metrics paragraph 29 (a) (i) (2)	Disclosure 305-2
Scope 3 Emissions - Upstream	metric tons of CO_2e	E1-6 Paragraph 41 (c)	Climate-related metrics paragraph 29 (a) (i) (3)	Disclosure 305-3
Scope 3 Emissions - Downstream	metric tons of CO_2e	E1-6 Paragraph 41 (c)	Climate-related metrics paragraph 29 (a) (i) (3)	Disclosure 305-3

Table 1. Alignment with reporting standards

3. Impact Driver Measurements

3.3 DATA SOURCES, GAPS, AND UNCERTAINTY

38. Preparers should strive to measure GHG emissions in a manner that is complete, neutral, and free from error. This includes faithfully representing the emissions from all value chain operations.

39. In practice, barriers such as cost or availability of data may limit preparers from measuring, in their entirety, Scope 1, 2, and 3 emissions. Alternative approaches that utilize estimates or proxies to calculate GHG emissions can be used when necessary to represent the full scope of GHG emissions[26].

40. In alignment with the GHG Protocol, preparers should prioritize approaches that[27,28]:

a. directly measure GHG emissions over those that estimate GHG emissions based on calculations from activity data (e.g., liters of fuel),

b. utilize primary data from specific activities within a company value chain over secondary data, and

c. consider sources of data that are of the highest quality possible.

41. In alignment with the GHG Protocol, high quality data sources should consider[29]:

a. technological representativeness. Does the data match the technology used?

b. temporal representativeness. Does the data represent the actual time or age of the activity?

c. geographical representativeness. Does the data reflect geographic considerations of the activity?

d. completeness. Is the data statistically representative of the activity?

e. reliability. Are the data sets or sources dependable?

42. When estimates require secondary data both Environmentally-extended input output (EEIO) models and process-based models can be used.

43. Uncertainty will arise when quantifying GHG emissions. Preparers should report qualitative uncertainty and, when possible, quantitative uncertainty. These may include but are not limited to propagated measured uncertainty, pedigree matrices, sensitivity analyses, or probability distributions[30].

26. The GHG Protocol maintains a list of third-party databases that can assist preparers in collecting necessary data for Scope 3 GHG emissions. https://ghgprotocol.org/life-cycle-databases

27. Adapted from Greenhouse Gas Protocol (2011): Corporate Value Chain (Scope 3) Accounting and Reporting Standard.

28. The Partnership for Carbon Accounting Financials (PCAF) also has resources to evaluate data quality based on the GHG Protocol. Specifically see PCAF (2022): The Global GHG Accounting and Reporting Standard Part A: Financed Emissions; Chapter 10 Annex.

29. Adapted from Table 7.6 from GHG Protocol (2011): Corporate Value Chain (Scope 3) Accounting and Reporting Standard.

30. The GHG Protocol provides approaches and calculation tools for estimating uncertainty of GHG emissions on the "Calculation Tools" section of their website. https://ghgprotocol.org/calculation-tools-and-guidance.

4. Outcomes, Impacts, and Valuation

4. Outcomes, Impacts, and Valuation

44. For GHG emissions, outcomes are changes to the physical environment from GHG emissions and impacts are changes in dimensions of people's well-being. Outcomes and impact valuation are done using the social cost of carbon (SCC) to develop the value factor. The valuation formula is then used to combine GHG emissions (outputs) to the value factor (outcome and impacts) to determine the negative cost of GHG emissions.

4.1 VALUATION FORMULA

45. To determine the monetary cost of GHG emissions (GHG $\text{Value}_{\text{Total}}$), preparers should use the following equation:

$$\sum(Em_{scope} * Vf) \text{ from Scope } 1\text{–}3 = \textbf{GHG Value}_{\textbf{Total}} \quad \text{(Eq. 1)}$$

where Em_{scope} represents GHG emissions from each scope category and Vf represents the value factor. The scopes considered in the sum include Scope 1, Scope 2, Scope 3 Upstream, and Scope 3 Downstream impacts.

Equation (1) can be broken out into four individual equations that can be written as:

$$Em_{scope1} * Vf = \textbf{GHG Value}_{scope1} \quad \text{(Eq. 2)}$$

$$Em_{scope2} * Vf = \textbf{GHG Value}_{scope2} \quad \text{(Eq. 3)}$$

$$Em_{scope3up} * Vf = \textbf{GHG Value}_{scope3upstream} \quad \text{(Eq. 4)}$$

$$Em_{scope3down} * Vf = \textbf{GHG Value}_{scope3downstream} \quad \text{(Eq. 5)}$$

46. Because GHG Emissions cause negative impacts to stakeholders via the impact pathway, the GHG $\text{Value}_{\text{Total}}$ is a negative value.

47. The value factor (Vf) is the same in all equations above and defined in section 4.2. The data needed for each Em_{scope} are provided by the preparer and guided by section 3.1, above. The definitions of each term are those used by the GHG Protocol.

48. Each scope of GHG emissions should be considered separately to increase transparency, comparability, and decision-usefulness.

4.2 VALUE FACTOR

49. To determine the value factor the *social cost of carbon* (SCC) approach is used. The SCC is calculated using *Integrated Assessment Models* (IAMs) that consider outcomes and impacts on society of each metric ton of CO_2e emitted. By considering socioeconomic futures, GHG emissions (outputs) are linked to changes in the physical environment (outcomes) and subsequent monetized damages (impacts). In the last step, future damages are *discounted* to present value. The output from an SCC model is a cost, in currency, of each metric ton of CO_2e emitted which is then used as the value factor[31].

50. Two models are used to determine the GHG value factor: The Greenhouse Gas Impact Value Estimator (GIVE)[32] and the Data-driven Spatial Climate Impact Model (DSCIM)[33]. The value factor developed from each model is averaged to produce a single value factor for use in impact accounts. This approach maximizes the distinctive and complementary strengths of each model.

51. The GIVE and DSCIM are significantly advanced over their predecessors and were chosen because they:

a. are built on extensive input data from a large representative sample of countries over longer time periods;

b. model impacts on society to the year 2300;

c. analyze impacts at either national or sub-national scales allowing for greater precision of analysis;

d. predict future impacts by also incorporating human adaptation in response to climate events;

e. can estimate uncertainty through all components of the model; and

f. are actively updated allowing The GHG Methodology to incorporate the latest advances in GHG emissions valuation.

31. See Appendix B: Methodological Details for further information about SCC models.
32. See Rennert et al. (2022): Comprehensive evidence implies a higher social cost of CO_2.
33. See The Climate Impact Lab (2022): Data-driven Spatial Climate Impact Model User Manual.

4. Outcomes, Impacts, and Valuation

52. The value factor uses a dynamic *discount rate* (Ramsey formula) calibrated to meet a near-term discount rate of 2%. Further information about each model, including approaches, assumptions, and uncertainty can be found in Appendix B.

53. Utilizing the considerations above, the value factor for GHG emissions that occur in the year 2023 and 2024 are $236 and $239 per metric tons of CO_2e, respectively (Box 1). Both values are adjusted for inflation to 2023 currency[34]. Future value factors are in Appendix C.

54. The value factor will be reviewed and updated regularly as outlined in Box 2. These updates will likely lead to increases in the value factor each year. These updates will be made to the value factor only without revision to the methodology itself.

Box 1. Value Factors	Box 2. Updating GHG value factors
$236 per metric ton of CO_2e for 2023 GHG emissions **$239** per metric ton of CO_2e for 2024 GHG emissions	The SCC used to determine the value factors will be updated regularly to take into consideration: **1.** adjustments for inflation, **2.** updated damage functions that more fully represent the impacts of GHG emissions, **3.** reduced discounting of damages as they are closer to present day, and **4.** advancements to the approved models that align with principles and concepts laid out in the General Methodology.

34. To increase comparability of impact accounts with other financial information, the value factor in future years will be adjusted for inflation. Two common approaches are to use the Consumer Price Index or the Gross Domestic Product Price Deflator.

5. Future Development

5. Future Development

55. The impact pathway and valuation methods presented in the GHG Methodology represent the current state of knowledge built upon decades of rigorous scientific work. But some limitations still exist including the ability of entities to have a complete accounting of Scope 1, 2, and 3 emissions and acknowledgement that the current cost of carbon is still underestimating impact.

56. There are opportunities to further advance impact accounting by exploring new pathways that overcome limitations and reduce uncertainty. Some of these include:

a. new methods and tools that allow for a more complete and accurate accounting of Scope 1, 2, and 3 emissions;

b. advancement of social cost of carbon models that incorporate additional damages and greater equity;

c. development of rigorous frameworks that incorporate GHG offsets and carbon credits into impact accounting; and

d. further incorporation of planetary thresholds and ambitious net-zero targets[35] into models for determining the cost of carbon itself.

57. Significant updates on any of the above, among other developments in the landscape will be used inform future updates to the GHG Methodology, which will be considered periodically.

35. Such as those set by the Science-based Targets Initiative.

Appendix A: Glossary

Appendix A: Glossary

TERM	DEFINITION	SOURCE[36]
Avoided Emissions (Scope 4 emissions)	Emission reductions that occur outside of a product's life cycle or value chain, but as a result of the use of that product. Examples of products (goods and services) that avoided emission include low temperature detergents, fuel-saving tires, energy-efficient ball-bearings, and teleconferencing services. Other terms used to describe avoided emissions include climate positive, net-positive accounting, and scope 4.	World Resources Institute (WRI)
Carbon Credit	One carbon credit is equivalent to one metric ton of carbon dioxide, or the equivalent amount of a different GHG reduced, sequestered, or avoided.	UNDP
Carbon Dioxide Equivalent (CO_2e)	A metric measure used to compare the emissions of the different greenhouse gases based upon their global warming potential (GWP). Greenhouse gas emissions in the United States are most commonly expressed as "million metric tons of carbon equivalents" (MMTCE). Global warming potentials are used to convert greenhouse gases to carbon dioxide equivalents.	UNFCCC
Carbon Offset Project	A specific project or activity designed to achieve GHG emission reductions, storage of carbon, or enhancement of GHG removals from the atmosphere. GHG projects may be stand-alone projects, or specific activities or elements within a larger non-GHG related project.	GHG Protocol
Carbon Offsets	A discrete GHG reduction used to compensate for (i.e., offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. Offsets are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the mitigation project that generates the offsets. To avoid double counting, the reduction giving rise to the offset must occur at sources or sinks not included in the target or cap for which it is used.	GHG Protocol
Direct Operations/ Operational Processes (Gate-to-Gate)	Covers activities over which the business has direct operational control, including majority owned subsidiaries.	Natural Capital Protocol
Discounting/Discount Rate	A mathematical operation that aims to make monetary (or other) amounts received or expended at different times (years) comparable across time. If the discount rate is positive, future values are given less weight than those today.	IPCC

36. Some definitions are adapted from the original source.

Appendix A: Glossary

TERM	DEFINITION	SOURCE[36]
Downstream Processes (gate-to-grave)	Covers activities linked to the purchase, use, re-use, recovery, recycling, and final disposal of the business' products and services.	Natural Capital Protocol
Ecosystem Services	The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth. The concept "ecosystem goods and services" is synonymous with ecosystem services.	The Millennium Ecosystem Assessment
Fugitive Emissions	Emissions that are not physically controlled but result from the intentional or unintentional releases of GHGs. They commonly arise from the production, processing transmission storage and use of fuels and other chemicals, often through joints, seals, packing, gaskets, etc.	GHG Protocol
Global Warming Potential (GWP)	The index used to translate the level of emissions of various gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emissions of one kilogram of a greenhouse gas to that from the emission of one kilogram of carbon dioxide over a period of time (usually 100 years).	UNFCCC
Greenhouse Gas (GHG)	Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).	UNFCCC
Impact	A change in one or more dimensions of people's well-being directly or through a change in the condition of the natural environment.	N/A (GM1)
Impact Accounting	The system for measuring and valuing the impacts of corporate entities and generating impact information to inform decisions related to sustainability performance.	N/A (GM1)
Impact Drivers	Refers to the sequence of an entity's inputs and outputs that may have positive and/or negative impacts on people's well-being.	Impact Management Platform (GM1)

Appendix A: Glossary

TERM	DEFINITION	SOURCE[36]
Impact Pathway	The series of consecutive, causal relationships, ultimately starting at an input for an entity's activities and linking its actions with related changes in people's well-being.	ISO (GM1)
Input	The resources and business relationships that the entity draws upon for its activities.	Impact Management Platform (GM1)
Integrated Assessment Models (IAMs)	Computational models of global climate change that include representation of the global economy and greenhouse gas emissions, the response of the climate system to human intervention, and impacts of climate change on the human system.	The National Academies of Science, Engineering, and Medicine
Mobile Combustion	Burning of fuels by transportation devices such as cars, trucks, trains, airplanes, ships, etc.	GHG Protocol
Monetized Impact	The process of assigning monetary values to climate related damages.	N/A
Outcome	The level of well-being experienced by people or condition of the natural environment that results from the actions of the entity, as well as from external factors. Outcomes are used to describe the one or more dimensions of people's well-being that are affected by an input, activity, and/or output.	Impact Management Platform (GM1)
Output	The direct result of an entity's activities, including an entity's products, services, and any by-products.	Impact Management Platform (GM1)
Physical Environment	Refers to abiotic, or non-living, components of Earth (e.g., atmosphere, climate, and weather attributes, etc.)	N/A
Process Emissions	Emissions generated from manufacturing processes, such as CO_2 that arise from the breakdown of calcium carbonate (CaCO3) during cement manufacturing.	GHG Protocol
Renewable Energy Certificate (REC)	A type of energy attribute certificate defined as representing the property rights to the generation, environmental, social, and other non-power attributes of renewable electricity generation.	GHG Protocol

Appendix A: Glossary

TERM	DEFINITION	SOURCE[36]
Scope 1 Emissions	Emissions from operations that are owned or controlled by the reporting company.	GHG Protocol
Scope 2 Emissions	Emissions from the generation of purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company.	GHG Protocol
Scope 3 Emissions	All indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.	GHG Protocol
Social Cost of Carbon (SCC).	The net present value of aggregate climate damages from one more metric ton of carbon in the form of carbon dioxide (CO_2), conditional on a global emissions trajectory over time.	IPCC
Stakeholders	Stakeholders are defined as those who can affect or be affected by the entity.	European Sustainability Reporting Standards (GM1)
Stationary Combustion	Burning of fuels to generate electricity, steam, heat, or power in stationary equipment such as boilers, furnaces, etc.	GHG Protocol
Upstream Processes (Cradle-to-gate)	Covers the activities of suppliers, including purchased energy.	Natural Capital Protocol

Appendix B: Methodological Details

Appendix B. Methodological Details

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Appendix B. Methodological Details

INTRODUCTION

B1. Analyses that assess the *monetized impacts* of climate change date back to the early 1990s[37]. These analyses, commonly termed the social cost of carbon (SCC), took a wide variety of approaches in early years to link GHG emissions with societal impacts. Dozens of models have been developed in the ensuing decades leading to ever-evolving approaches and significant advances in quantification of GHG emission impacts. Today numerous countries, entities, and municipalities utilize the SCC approach to measure the impacts of GHG emissions.

B2. Of the various models used to value SCC, two have emerged as significantly advanced over their predecessors: the Greenhouse Gas Impact Value Estimator (GIVE) produced by Resources for the Future and the University of California Berkeley[38] and the Data-driven Spatial Climate Impact Model (DSCIM) produced by the Climate Impact Lab[39]. While there are some differences in the approaches of each model, they are notable improvements over their predecessors due to higher resolution input data from more countries and over longer time periods, the ability to produce outputs at a finer spatial resolution, damage models that build in human adaptation in response to climate events, prediction of damages through the year 2300, and the ability to estimate uncertainty through all modules.

B3. Each model excels in distinct areas. DSCIM predicts impacts at a sub-national spatial resolution meaning that predictions are more precisely tied to local factors. DSCIM also has an advanced adaptation model which predicts how society and markets will evolve in response to climate damages. GIVE runs at the country spatial resolution and can represent decisions at national scales. The more advanced socio-economic projections come from the GIVE research group as well, providing ideal complementary information. Finally, a recent synthesis of the SCC literature conducted by the United States EPA concluded that these two models represent the most advanced approaches to calculating an SCC and used it for their updated guidance for cost-benefit analysis for the United States federal government[40].

BACKGROUND

B4. Estimating the SCC requires linkages across fields that span multiple sciences, including earth sciences, climate science, economics, sociology, and biology. Estimate of the SCC typically use integrated Assessment Models (IAMs) and each model can vary significantly in approach, underlying data resolutions, and feedback mechanisms. However, these IAMs typically have a similar structure including four modules: (1) socioeconomics and emissions, (2) climate, (3) damages, and (4) discounting (Figure B1).

B5. Within the IAM structure, each module produces information that is used by the next module. The socioeconomics and emissions module projects future GDP and human population, allowing future projections of anthropogenic GHG emissions to be created. Projections of GHG emissions become the inputs of the climate module. The climate module translates these GHG emissions into future CO_2 concentrations, temperatures, and sea level rise. The damage module uses the changes to the physical environment along with socioeconomic variables to produce societal economic damages. At this point in the process, the entire model is run twice. In the first iteration, the model is run as is with no additions (e.g., the 'baseline' iteration). In the second iteration, the model is run with an additional pulse of GHG emissions at a particular year of interest. This results in SCC estimates over an expected timescale in which the additional pulse of GHG emissions is expected to cause monetary impact. Finally, the discounting model translates multi-year, monetized economic damages into present-day monetary values (i.e., the year at which the unit of emissions was released).

37. See Nordhaus 1991: Economic approaches to greenhouse warming; Frankhauser 1996: Climate change costs: recent advancements in the economic assessment.
38. See Rennert et al. (2022): Comprehensive evidence implies a higher social cost of CO_2.
39. See Climate Impact Lab (2022): Data-driven Spatial Climate Impact Model User Manual, Version 092022- EPA.
40. See EPA (2022): Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Science Advances.

Appendix B. Methodological Details

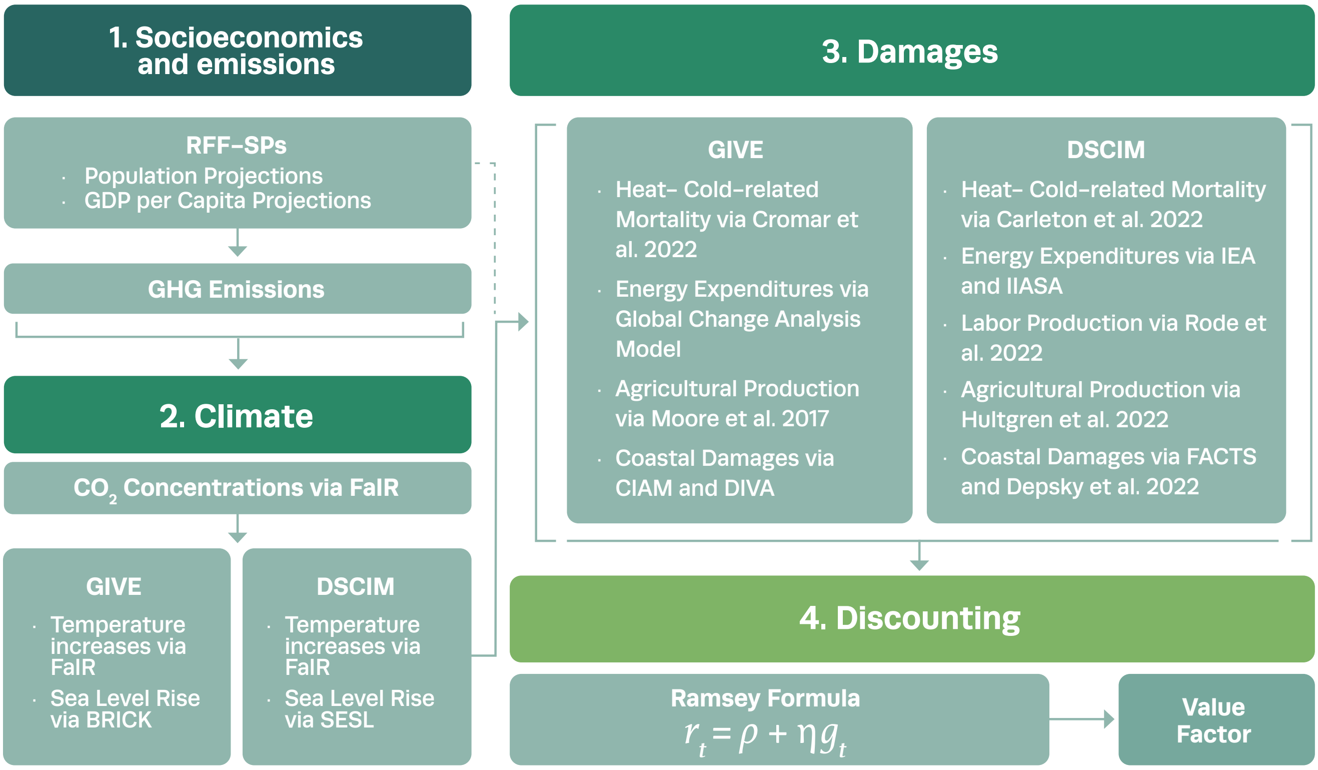

Figure B1. Diagram of the four modules that are used to develop a value factor via integrated assessment models including approaches used by GIVE and DSCIM.

SOCIOECONOMIC AND EMISSIONS MODULE

B6. The Socioeconomic and Emissions Module represents the first step in the SCC process. Information within this module serves two purposes: (1) to model future GHG emissions, which serves as the input for the climate module, and (2) provide projections of GDP and human population, which serve as inputs for the damage and discounting modules. Socioeconomic trajectories are significant predictors of climate damages because population increases and income levels together increase GHG emissions and lead to more willingness for climate change avoidance[41]. A pulse of GHGs emitted today will have long-lasting effects on the planet. As a result, it is crucial that parameters used in the SCC valuation process (1) are projected far into the future, (2) account for future regulatory policies and technological advancements, (3) incorporate the complex uncertainties associated with each estimate and (4) are disclosed in a transparent fashion.

B7. Both GIVE and DSCIM utilize models developed under the Resources for the Future Social Cost of Carbon Initiative (called RFF-SPs)[42], which are designed to produce socioeconomic projections through the lens of SCC estimates. The RFF-SPs build probabilistic projections of human population and GDP to the year 2300. RFF-SPs have the capacity to capture uncertainty created due to a variety of factors, including the effect of future technological advances and emissions mitigation policies.

B8. For human population estimates, the mean RFF-SP population trajectory shows a gradual increase in human population until a peak of ~11 billion around the year 2100, followed by a gradual decline beyond the year 2300, at which the population is under 10 billion. Projected mean RFF-SP GDP per capita growth rates remain relatively consistent at 1.6% until 2100. Values decline gradually between 2100-2200, leveling off to 1.1% in the year ~2200. The mean RFF-SP projection predicts CO_2 emissions will peak before 2050, followed by a gradual decline towards net-zero emissions through 2300.

41. Ibid, 38

42. See Rennert et al. 2022, The Social Cost of Carbon: Advances in Long-Term Probabilistic Projections of Population, GDP, Emissions, and Discount Rates.

Appendix B. Methodological Details

CLIMATE MODULE

B9. The climate module uses emissions projections to model future physical climate variables – namely, CO_2 concentrations, temperature, and sea level rise (SLR). This process starts by modelling the impact GHG emissions projections have on energy imbalance imposed on the climate system (i.e., radiative forcing), accounting for heat uptake by the world's oceans. This process allows for the projection of important climate variables (e.g., sea level rise) which serve as inputs to the damage module. The final input relayed to the damage module is estimated by creating a modelled baseline scenario (represented by the RFF-SPs themselves, a scenario without a given pulse of emissions) and comparing the results to a scenario in which a pulse of GHG emissions is produced in the year of interest.

B10. Both GIVE and DSCIM determine climate responses (in terms of the global climate system and carbon dynamics) by utilizing version 1.6.2 of the Finite Amplitude Impulse Response (FaIR) model[43,44]. FaIR has been used extensively in peer-reviewed literature and includes methodological transparency, model[45] simplicity, accuracy, and disclosure of uncertainty.

B11. GIVE and DSCIM use different models to project sea level rise (SLR). GIVE uses the Building blocks for Relevant Ice and Climate Knowledge (BRICK) model[46]. BRICK estimates SLR by incorporating data from glacier, ice cap, and ice sheet melting, oceanic thermal expansion, and land water storage. BRICK also models tipping point events, such as rapid ice sheet melting when threshold temperatures are crossed. DSCIM projects SLR by using the Semi-Empirical Sea Level (SESL) to predict global mean sea levels and temperatures with and without an emissions pulse[47]. This information is used to determine global mean sea level changes over time. Estimate uncertainty is incorporated using the Framework for Assessing Changes to Sea-level (FACTS). FACTS creates SLR alternative probability distributions of global SLR, regional SLR, and extreme levels of SLR that are aligned with results presented in the IPCC's AR6[48].

DAMAGE MODULE

B12.The damage module converts changes to the physical environment to monetized damages (impacts). The outputs of the damage module can be generally divided into market damages (e.g., changes to agricultural productivity) and non-market damages (e.g., mortality rates)[49]. GIVE and DSCIM differ markedly in their approach to the damage module, which is discussed below.

B13. The GIVE model has, thus far, incorporated four damages: heat- and cold-related mortality, energy expenditures, agricultural productivity, and coastal effects including land/capital loss and mortality.

a. GIVE incorporates heat- and cold- related mortality estimates using results from a comprehensive meta-analysis[50] which estimated the effects of incremental temperature increases of 1˚C on categorical mortality risks (e.g., cardiovascular, respiratory, gastrointestinal, etc.). Excess mortality estimates are monetized by using the EPA's 1990 Guidance value for a statistical life (VSL) of $4.8 million, adjusted to $10.05 million in 2020 dollars[51].

b. Energy expenditures are modeled by linking temperature effects of climate change to country-level increases in electricity expenditures through 2100 using the Global Change Analysis Model[52,53]. Country-level energy expenditures are monetized by multiplying excess energy expenditure by prices of those utility services and scaling globally by comparing country-level GDP.

43. See the 'Climate models' subsection of the Methods in Rennert et al. 2022: Comprehensive evidence implies a higher social cost of CO_2; See Section 3.2 in Climate Impact Lab (2022): Documentation for Data-driven Spatial Climate Impact Model (DSCIM).
44. The Finite Amplitude Impulse Response (FaIR) model can be accessed via: https://docs.fairmodel.net/en/latest/
45. See Climate Impact Lab (2022): Data-driven Spatial Climate Impact Model User Manual, Version 092022- EPA
46. See Wong et al. (2017): BRICK v0.2, a simple, accessible, and transparent model framework for climate and regional sea-level projections.
47. See Climate Impact Lab (2022): Data-driven Spatial Climate Impact Model User Manual, Version 092022- EPA
48. See Kopp et al. (2023): The framework for assessing changes to sea-level (FACTS) v1.0-rc: A platform for characterizing parametric and structural uncertainty in future global, relative, and extreme sea-level change.
49. See Section 2.3: Damage Module of EPA (2022): Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Science Advances.
50. See Cromar et al. (2022): Global health impacts for economic models of climate change: A systematic review and meta-analysis.
51. See discussion in Chapter 7, page 8 of U.S. Environmental Protection Agency (2010): Guidelines for Preparing Economic Analyses.
52. See Clarke et al. (2018): Effects of long-term climate change on global building energy expenditures.
53. See Edmonds et al. (2004): Stabilization of CO_2 in a B2 world: insights on the roles of carbon capture and disposal, hydrogen, and transportation technologies.

Appendix B. Methodological Details

c. Agricultural productivity damages are determined using research provided by Moore et al. 2017[54], who determined the effects of rising temperatures on agricultural yield shocks by (1) creating a meta-analysis of 1010 published estimates of yield responses of maize, rice, wheat, and soybeans to climate change and (2) monetizing these impacts via the widely used Global Trade Analysis Project (GTAP) general equilibrium model, which comprehensively tracks global bilateral trade flows and models the production and consumption of commodities for all national economies[55].

d. Finally, GIVE incorporates coastal damages via the Coastal Impacts and Adaptation Model (CIAM), which assesses the costs associated with various flooding damage adaptation strategies as well as impacts to regional coastlines due to SLR[56]. Coastal impacts are monetized via the Dynamic Interactive Vulnerability Assessment (DIVA) database, selecting the least-cost strategy for region-specific coastlines[57].

B14. DSCIM incorporates five damage categories: heat- and cold- related mortality, energy expenditures, labor productivity, and agricultural damages.

a. DSCIM estimates heat- and cold- related mortality by deriving age-specific relationships between temperature and mortality using subnational data from 40 countries (1990-2020)[58]. Similar to GIVE, heat- and cold- related mortality is monetized using the EPA's VSL adjusted to 2019 dollars[59].

b. Electricity expenditures are incorporated using information provided by an estimate of climate change on global energy consumption[60]. This research utilizes electricity and other fuel usage from 146 countries between 1971-2010 from the International Energy Agencies' (IEA) World Energy Balances dataset[61]. These impacts are monetized using two data sources – present-day electricity costs are provided by region via the IEA's World Energy Outlook 2017[62], and other fuel costs are obtained from the International Institute for Applied Systems Analysis (IIASA) Scenario Explorer database[63].

c. Labor productivity damages are represented by the relationship between temperature increases and labor losses, measured in terms of labor disutility[64]. Increases in daily temperatures have been connected to hour reductions for workers in industries where outdoor work is required, such as in construction, agriculture, transportation, and more. The compensating wage increase required to counteract the labor disutility is used to monetize the impact.

d. Agricultural production damages are determined by analyzing the impacts on six staple crops which represent ~two-thirds of global crop caloric production – maize, wheat, rice, soy, sorghum and cassava[65]. Agricultural damages are monetized by incorporating the economics surrounding agricultural adaptations, including costs, benefits and adaptation adoption rates, while also accounting for the beneficial effects of CO_2 fertilization[66].

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54. See Moore et al. (2017): New science of climate change impacts on agriculture implies higher social cost of carbon.
55. Ibid, 52.
56. See Diaz (2016): Estimating global damages from sea level rise with the Coastal Impact and Adaption Model (CIAM).
57. See Vafeidis et al. (2008): A new global coastal database for impact and vulnerability analysis to sea-level rise.
58. See Carleton et al. (2022): Valuing the global mortality consequences of climate change accounting for adaptation costs and benefits.
59. Ibid.
60. See Rode et al. (2021): Estimating a social cost of carbon for global energy consumption, Nature.
61. Dataset can be accessed via IEA: https://www.iea.org/data-and-statistics/data-product/world-energy-balances#data-sets
62. DSCIM documentation notes that "Costs are specified for the following geographies: Japan, European Union, Korea, Brazil, Australia, Mexico, Southeast Asia, Middle East, India, Africa, United States, China, Canada, Russia. When a cost is not available specific to a particular geography, we extend these costs based on UN world region classifications: Oceania receives the Australia cost, N., S., and W. Europe receive the EU cost, E. Europe receives the Russia cost, Central America/Caribbean receive the Mexico cost, S. America receives the Brazil cost, N. Africa receives the Middle East cost, and S. Asia receives the India cost." See footnote 55 in Climate Impact Lab (2022): Documentation for Data-driven Spatial Climate Impact Model (DSCIM).
63. Scenario explorer database can be accessed via IIASA (2022): https://data.ece.iiasa.ac.at/ar6/#/login?redirect=%2Fworkspaces
64. See Rode et al. (2021): Estimating a social cost of carbon for global energy consumption, Nature.
65. See Hultgren et al. (2022): Estimating global impacts to agriculture from climate change accounting for adaptation.
66. See Moore et al. (2017): New science of climate change impacts on agriculture implies higher social cost of carbon.

Appendix B. Methodological Details

e. Finally, coastal damages are accounted for by determining the effects of SLR on coastal inundation. As discussed in the climate section, DSCIM utilizes the FACTS model to provide global SLR projections. Coastal damages are monetized via the DSCIM-Coastal v1.0 modelling platform[67] which incorporates costs related to inundation, infrastructure/population retreat, construction/maintenance, wetlands, mortality, and physical capital losses from SLR.

B15. Both GIVE and DSCIM include transparent modelling techniques that incorporate uncertainty parameters for each damage function[68,69].

B16. Both GIVE and DSCIM are iterative models that will continue to be updated as state-of-the-art modeling techniques and further information becomes available. Active research is exploring biodiversity, ecosystem services, labor productivity, wildfire, ocean impacts, conflict, and migration damages. As more categories of damages are added to these IAMs, estimates of SCC are likely to increase. Thus, current SCCs determined by IAMs are likely underestimates of the total impact of GHGs.

DISCOUNTING MODULE

B17. Damages from carbon emitted today cause long-lasting impacts on stakeholders including future generations. In the discounting module, future marginal damages determined by the damages module are discounted to present day values.

B18. The prevailing approach to discounting climate-related impacts is to use the Ramsey formula[70] to create a dynamic discount rate. Generally, the Ramsey formula is denoted as: $r_t = \rho + \eta g_t$

B19. Where r_t represents the discount rate at time t, ρ represents the rate of pure time preference, g_t represents the mean consumption growth rate in year *t*, and η represents the elasticity of marginal utility of consumption. By utilizing this formula, a dynamic discount rate is created that responds to changes in the consumption growth rate.

B20. The pure rate of time preference (ρ) considers how much we discount the future simply because it is in the future. There is some convergence among economists and philosophers that the pure rate of time preference should be low or near zero as an ethical stance on intergenerational equity[71,72]. The elasticity of marginal utility of consumption (η) considers the rate at which marginal utility of consumption changes as society grows richer. This parameter is acknowledging that richer societies value one dollar less than poorer societies (Diminishing Marginal Utility of Income). Most current studies propose that this parameter should be driving discount rates[67].

B21. Both GIVE and DSCIM have been implemented with the Ramsey formula using parameters that correspond to a near-term target discount rate of 2%. This leads to a pure rate of time preference (ρ) of 0.20% and an elasticity of marginal utility of consumption (η) of 1.24[73].

67. See Depsky et al. (2022): DSCIM-Coastal v1.0: An Open-Source Modeling Platform for Global Impacts of Sea Level Rise.
68. See Rennert et al. (2022): Comprehensive evidence implies a higher social cost of CO_2.
69. See section 4: Damages Module in Climate Impact Lab (2022): Data-driven Spatial Climate Impact Model User Manual, Version 092022- EPA.
70. See Ramsey, F.P., 1928. A mathematical theory of saving.
71. See Carleton & Greenstone (2022): A guide to updating the US government's social cost of carbon.
72. See Nesje et al. (2023): Philosophers and economists agree on climate policy paths but for different reasons.
73. See Rennert et al. (2022): Comprehensive evidence implies a higher social cost of CO.

Appendix C: Future Value Factors and Example Calculations

Appendix C. Future Value Factors and Example Calculations

Table C1 provides value factors for emissions that occur in each year from 2020 to 2030 based on current projections. These values are intended for analysis that is considering forward or backward-looking projections from the present year. For the years 2020 – 2022, the value factors have been adjusted for inflation to the year in reference (e.g., the 2020 Value Factor is in 2020 U.S. Dollars). All values for future years in this table are in 2023 U.S. Dollars.

In this Table, the value factor increases each year because of discounting. Each model predicts damages that will occur each year from the present to the year 2300. As the model approaches each year where those impacts occur, the damages are discounted less because they are closer to present day.

Please note, when referencing Table C1, that these values will vary from the value factor updated each year that are used in the methodology based on the evolving nature of SCC models and the reasons outlined in Box 2.

Year of GHG Emissions	Value Factor ($/metric ton CO_2e)		
	Average	GIVE	DSCIM
2020	$190	$190	$190
2021	$205	$205	$204
2022	$223	$223	$224
2023	$236	$234	$236
2024	$239	$237	$242
2025	$244	$240	$247
2026	$248	$244	$252
2027	$252	$247	$257
2028	$256	$250	$262
2029	$260	$254	$267
2030	$265	$257	$272
2031	$269	$261	$277
2032	$273	$264	$282
2033	$277	$267	$287
2034	$281	$271	$292
2035	$286	$274	$298

Table C1. Value factors developed from GIVE, DSCIM and Averaged.

Appendix C. Future Value Factors and Example Calculations

Example Calculation.

Consider a theoretical company with the following GHG emissions profile from the year 2023:

- Scope 1: 200,000 metric tons of CO_2e
- Scope 2: 300,000 metric tons of CO_2e
- Scope 3 Upstream: *4 million* metric tons of CO_2e
- Scope 3 Downstream: *1 million* metric tons of CO_2e

To develop impact accounts, preparers can use equations 1 – 5 from section 4.1.
Because the emission occurred in 2023, the value factor of $236 can be used.

First, equation 2 can be used to determine Scope 1 Impact:

$Em_{scope1} * Vf = \textbf{GHG Value}_{scope1}$ (Eq. 2)

$200{,}000\ CO_2e * \$236 = \textbf{\$47.2 million}$ (Eq. 2)

Then, equation 3 can be used to determine Scope 2 Impact:

$Em_{scope2} * Vf = \textbf{GHG Value}_{scope2}$ (Eq. 3)

$300{,}000\ CO_2e * \$236 = \textbf{\$70.8 million}$ (Eq. 3)

Then, equation 4 can be used to determine Scope 3 Upstream Impact:

$Em_{scope3up} * Vf = \textbf{GHG Value}_{scope3upstream}$ (Eq. 4)

$4\ million\ tonnes\ CO_2e * \$236 = \textbf{\$944 million}$ (Eq. 4)

Then, equation 5 can be used to determine Scope 3 Downstream Impact:

$Em_{scope3down} * Vf = \textbf{GHG Value}_{scope3downstream}$ (Eq. 5)

$1\ million\ tonnes\ CO_2e * \$236 = \textbf{\$236 million}$ (Eq. 5)

Then, equation 1 can be used to determine Total Impact:

$\sum(Em_{scope} * Vf)$ from Scope 1 – 3 = $\textbf{GHG Value}_{Total}$ (Eq. 1)

$\$47.2\ million + \$70.8\ million + \$944\ million + \$236\ million = \textbf{\$1.298 billion}$

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