Template for submitting proposals related to GHG Protocol's *Corporate Standard, Scope 2 Guidance, Scope 3 Standard, Scope 3 Calculation Guidance* and market-based accounting approaches

(Optional)

Proposal instructions

GHG Protocol is conducting four related surveys in reference to the following GHG Protocol standards, guidance and topics:

1. Corporate Accounting and Reporting Standard (Revised Edition, 2004) ("Corporate Standard")
2. Scope 2 Guidance (2015)
3. Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011) ("Scope 3 Standard"), and Technical Guidance for Calculating Scope 3 Emissions, version 1.0, 2013 ("Scope 3 Calculation Guidance")
4. Market-based accounting approaches

The survey is open until February 28, 2023. To fill out the survey, click here.

As part of the survey process, respondents may provide proposals for potential updates, amendments, or additional guidance to the *Corporate Standard, Scope 2 Guidance, Scope 3 Standard, or Scope 3 Calculation Guidance*, by providing the information requested in this template. You may also use this template to provide justification for maintaining a current approach on a given topic.

Submitting proposals is optional. Respondents may submit multiple proposals related to different topics.

Proposals should be as concise as possible while providing the requested information. Submissions that are outside of the template may not be considered. Proposals may be made publicly available.

To submit the proposal, please save this file and fill out the fields below. When you've completed your proposal, please upload the file via this online folder. Please name your file STANDARD_Proposal_AFFILIATION, e.g., *Scope 2_Proposal_WRI*.

Proposal and supporting information

1. **Which standard or guidance does the proposal relate to (Corporate Standard, Scope 2 Guidance, Scope 3 Standard, Scope 3 Calculation Guidance, general/cross-cutting, market-based accounting approaches, or other)? If other, please specify.**

Scope 2 Guidance

2. **What is the GHG accounting and reporting topic the proposal seeks to address?**

Location-based accounting

3. What is the potential problem(s) or limitation(s) of the current standard or guidance which necessitates this proposal?

In the time since the previous Scope 2 guidance was published, the scientific understanding of how to accurately allocate generated electricity emissions to consumers has substantially evolved, as has the sophistication and availability of data to enable such accounting. Previously, the only emission factors that were widely available for location-based accounting were annual-averages for broad geographic regions that did not accurately reflect imports and exports of electricity. These existing regional averages were based on a mental model of the grid that treated it as a "bathtub," i.e. that within the regional boundaries all electricity users consumed the same mix of generated electricity. However, our understanding has evolved to better align with the power systems engineering understanding that the grid is more like a network of pipes or tributaries that flow in different directions and at different rates. Thus, the carbon intensity of electricity consumed depends on the consumer's location within the power network relative to power generators and power flows.

The ability to create accurate, temporally and spatially granular emission factors that explicitly account for power flows between and within regions has been enabled by a proliferation of previously unpublished data about the power system being made available in near real time. The availability of these data has led to new academic research on the topic of granular consumption-based accounting of emissions that considers the underlying physical power system structure, as well as a proliferation of new emission factor datasets.

Recent academic research published within the past few years has illustrated why granular accounting of consumption-based emissions is important for accurate accounting of location-based emissions. A 2022 study by Miller et al. compared scope 2 inventories for thousands of buildings across the U.S. calculated at different temporal resolutions. They summarized: "Our results show that annual-average accounting can over- or under-estimate carbon inventories as much as 35% in certain settings but result in effectively no bias in others. Bias will be greater in regions with high variation in carbon intensity, and for end-users with high variation in their electricity consumption across hours and seasons. As variation in carbon intensity continues to grow with growing shares of variable and intermittent renewable generation, these biases will only continue to worsen in the future. In most cases, using monthly-average emission factors does not substantially reduce bias compared to annual averages. Thus, the authors recommend that hourly accounting be adopted as the best practice for emissions inventories of consumed electricity."

Multiple studies comparing the use of generation-average emission factors to consumption-based averages that account for interchanges of electricity in both the U.S. and Europe have found that generation averages can substantially misrepresent the emission intensity of consumed electricity. One study found that imported electricity can account for 20-40% of the emissions consumed in a region. This can have substantial impacts on the allocational accuracy of location-based accounting. Furthermore, a growing body of research that applies power flow tracing techniques to trace carbon emissions ("carbon flow") through transmission networks has found that the carbon intensity of consumed electricity can vary substantially from one transmission node or bus to the next, suggesting that regional average emission factors may not always accurately represent the carbon intensity for each consumer.

It is time to update the location-based accounting guidance to reflect these advancements in scientific understanding and data sophistication.

4. Describe the proposed change(s) or additional guidance.

Re-focus on granular, consumption-based accounting to align with underlying physical power flows. We now understand that the emissions intensity of consumed electricity can vary substantially across time and space - within the hours of a single day, and within a single grid region. We also better understand the extent to which physical flows of electricity across (and within) regional boundaries make the carbon intensity of consumed electricity diverge from the carbon intensity of generated electricity in that region. The location-based guidance should be updated to re-emphasize an exclusive focus on consumption-based accounting of electricity to align with underlying physical power flows, rather than allowing for the use of regional generation emission factors.

Consider renaming "location-based". The term "location-based" accounting implies that the location of a reporter is the most salient factor for accounting, even if the timing of electricity consumption, and the flow of electricity across locational boundaries are equally important. When the protocol was last written, location was an important factor since the definition of emission factors depended entirely on drawing geographic boundaries for a region. However, with today's power flow-based tracing of emissions through the system, locational boundaries are less relevant. We suggest that this accounting method be renamed to better reflect the approach and theory of change used. Potential options could include "consumption-based" , "physics-based", or "flow-based" accounting.

Expand the use of emission factor hierarchies. Recognizing that not all reporters may have access to or be able to use the most temporally or spatially granular consumption-based emission factor data, we recommend the introduction of several new emission factor hierarchies that make explicit the "best" temporal and spatial granularities that can be used. These should be paired with a framework explaining that the choice of emission factor should also be informed by the granularity of the electricity consumption data itself. For example if a reporter only has access to monthly-total electricity consumption data, it would not make sense to use higher-resolution emission factor data.

A temporal granularity hierarchy could include hourly or sub-hourly factors at the top, followed by monthly, followed by annual averages at the very bottom. There is still additional research needed to define appropriate and universal levels of spatial granularity, but a spatial granularity hierarchy could include distribution feeders or substations at the top, followed by transmission nodes/buses, then sub-balancing area congestion zones, then balancing authorities, and at the very bottom the boundaries of the interconnect or synchronous grid. We would recommend against including national or other political boundaries in the emission factor hierarchy since these do not always reflect relevant physical grid boundaries (e.g. in the U.S. a national boundary would include at least five distinct interconnections that are electrically distinct areas: the Western Interconnect, Texas, the Eastern Interconnection, Alaska, and Hawaii).

Expand the consumption-based theory of change. Finally, the availability of granular, consumption-based grid emissions data should prompt an update to the theory of change for consumption-based accounting. The current "decision-making" value of low-resolution, location-based accounting is quite limited. However, this new data enables a wider range of actions that can be taken to influence one's consumption-based footprint, including: temporal and spatial load shaping and shifting; investment in transmission infrastructure upgrades that enable more delivery of clean energy; investment in onsite and local clean energy resources; policy

engagement to affect the regional supply mix. Indeed, even market-based / contract-based decisions can influence one's location-based emissions footprint, although the impact of those decisions is spread among grid users.

5. Please explain how the proposal aligns with the GHG Protocol decision-making criteria and hierarchy (A, B, C, D below), while providing justification/evidence where possible.

A. GHG Protocol accounting and reporting approaches shall meet the GHG Protocol accounting and reporting principles (see Annex for definitions):

- Accuracy, Completeness, Consistency, Relevance, Transparency
- Additional principles for land sector activities and CO_2 removals: Conservativeness, Permanence, and Comparability if relevant

Accuracy: Aligning the guidance around granular, consumption-based accounting that incorporates the underlying physical power system structure would help reduce systematic misrepresentations and misallocations of emissions to consumers of electricity, and will substantially increase the accuracy of location-based accounting, especially as the temporal and spatial variation in grid carbon intensity continues to increase over time.

Completeness: N/A

Consistency: N/A

Relevance: These updates would provide carbon intensity data that is most relevant to each consumer of electricity based on their consumption patterns. These changes also make location-based accounting data more actionable in that it introduces new ways in which reporters can affect their location-based emissions footprint.

Transparency: N/A

B. GHG Protocol accounting and reporting approaches shall align with the latest climate science and global climate goals (i.e., keeping global warming below 1.5°C). To support this objective (non-exhaustive list):

- Direct emissions reported in a company's inventory should correspond to emissions to the atmosphere. Reductions in direct emissions reported in a company's inventory should correspond to reductions in emissions to the atmosphere.
- Indirect emissions reported in a company's inventory should in the aggregate correspond to emissions to the atmosphere. Reductions in indirect emissions reported in a company's inventory should in the aggregate correspond to reductions in emissions to the atmosphere.

This update is most relevant to how total emissions from the power sector are allocated to end consumers of electricity, rather than to the total emissions reported.

C. GHG Protocol accounting frameworks should support ambitious climate goals and actions in the private and public sector.

- Would this proposal enable organizations to pursue more effective GHG mitigation/decarbonization efforts as compared to the existing standards and guidance? If so, how?
- Would this proposal better inform decision making by reporting organizations and their stakeholders (e.g. related to climate-related financial risks and other relevant information associated with GHG emissions reporting)?

This proposal supports more effective GHG mitigation efforts and would better inform decision-making compared to the existing guidance. For example, greater temporal granularity can help prioritize the most effective energy efficiency projects based on whether they reduce electricity at the times of day when electricity is the most carbon intensive. Accounting for consumption-based emissions also allows reporters to more accurately understand the power generation that they are responsible for consuming, even if that power generation occurs in a neighboring region to reflect the emissions obligations accurate in order to prevent "emissions outsourcing".

D. GHG Protocol accounting frameworks which meet the above criteria should be feasible. (For aspects of accounting frameworks that meet the above criteria but are difficult to implement, GHG Protocol should provide additional guidance and tools to support implementation.)

- What specific information, data or calculation methods are required to implement this proposal (e.g., in the case of scope 2, data granularity, grid data, consumption data, emission information, etc.)? Would new data/methods be needed? Are current data/methods available? How would this be implemented in practice?
- Would this proposal accommodate and be accessible to all organizations globally who seek to account for and report their GHG emissions? Are there potential challenges which would need to be further addressed to implement this proposal globally? What would be the potential solutions?

The use of hierarchies paired with a "best available data" standard provides the flexibility for reporters to feasibly report emissions no matter what data they have available to them.

The feasibility of using consumption-based emission factors is based on the availability of these data. These factors are increasingly available globally from a number of data providers. Calculating consumption-based emissions only requires data on the generation mix within each region, and the flows of electricity between or within regions.

The feasibility of carbon accounting at an hourly resolution or higher depends on four factors: the availability of hourly electricity metering data, the availability of high-quality hourly grid emissions data, the existence of guidance on standardized approaches for performing hourly accounting, and the real and perceived complexity of working with hourly data.

Hourly-resolution or better electricity metering data is becoming more and more widespread. According to the U.S. EIA, in the United States, advanced metering infrastructure (AMI), which is

capable of hourly or sub-hourly readings, in 2021 made up over two-thirds of all electricity meters installed in the U.S., up from only 39% of all meters in 2013.

Hourly or better resolution datasets of carbon intensity are now widely available from a number of government and private sources, including the U.S. EIA, Electricity Maps, and Singularity Energy.

The GHG protocol itself has the opportunity to remove the third barrier by providing clear, standardized guidance on hourly accounting.

Moving from annual-resolution to hourly-resolution data does require working with a larger volume of data. However, these calculations can still easily be performed in a spreadsheet, and a growing number of software platforms are emerging to help reporters manage the complexity of collecting and aggregating hourly data for accounting.

6. Consistent with the hierarchy provided above, are there potential drawbacks or challenges to adopting this proposal? If so, what are they?

We do not envision any major challenges with adopting this proposal. The use of hierarchies provides the flexibility to calculate an inventory no matter the level of sophistication or the availability of data.

The major drawback of this approach, which is shared by the existing framework, is that the flexibility provided by hierarchies means that different reporters may use different quality approaches to calculating their inventories, which means that the inventories may not be directly comparable, or may not in aggregate sum to 100%. However, the alternative is to prescribe a single methodological approach and source of emission factor data that must be used by all reporters, which may not be practical.

7. Would the proposal improve alignment with other climate disclosure rules, programs and initiatives or lead to lack of alignment? Please describe.

Other programs are increasingly recognizing the importance of granular, consumption-based accounting of emissions as well. However, many climate disclosure rules and programs embed the scope 2 guidance within their design, so these programs will by definition be aligned with the scope 2 guidance no matter how it is changed.

8. Please attach or reference supporting evidence, research, analysis, or other information to support the proposal, including any active research or ongoing evaluations. If relevant, please also explain how the effectiveness of the proposal can be evaluated and tracked over time.

The main evidence supporting the need for temporally granular emissions accounting is a 2022 paper by Miller et al titled “Hourly accounting of carbon emissions from electricity consumption,” available at https://iopscience.iop.org/article/10.1088/1748-9326/ac6147/meta. This includes a review of all

previous literature on this topic and an analysis of if and when hourly-resolution accounting of emissions is more accurate than annual-resolution accounting.

There are a number of research articles that support the need for flow-based accounting of consumed emissions, including:

- Marriott, J. & Matthews, H. S. Environmental Effects of Interstate Power Trading on Electricity Consumption Mixes. Environ. Sci. Technol. 39, 8584–8590 (2005). https://pubs.acs.org/doi/10.1021/es0506859
- Tranberg, B. et al. Power flow tracing in a simplified highly renewable European electricity network. New J. Phys. 17, 105002 (2015). https://iopscience.iop.org/article/10.1088/1367-2630/17/10/105002
- Kodra, E., Sheldon, S., Dolen, R. & Zik, O. The North American Electric Grid as an Exchange Network: An Approach for Evaluating Energy Resource Composition and Greenhouse Gas Mitigation. Environ. Sci. Technol. 49, 13692–13698 (2015). https://pubs.acs.org/doi/10.1021/acs.est.5b03015
- Ji, L. et al. Greenhouse gas emission factors of purchased electricity from interconnected grids. Applied Energy 184, 751–758 (2016). https://www.sciencedirect.com/science/article/abs/pii/S0306261915012921
- Qu, S., Liang, S. & Xu, M. CO2 Emissions Embodied in Interprovincial Electricity Transmissions in China. Environ. Sci. Technol. 51, 10893–10902 (2017). https://pubs.acs.org/doi/10.1021/acs.est.7b01814
- Tranberg, B. et al. Real-time carbon accounting method for the European electricity markets. Energy Strategy Reviews 26, 100367 (2019). https://www.sciencedirect.com/science/article/pii/S2211467X19300549
- Chalendar, J. A. de, Taggart, J. & Benson, S. M. Tracking emissions in the US electricity system. PNAS (2019) doi:10.1073/pnas.1912950116.
- Schäfer, M., Tranberg, B., Jones, D. & Weidlich, A. Tracing carbon dioxide emissions in the European electricity markets. http://arxiv.org/abs/2008.00893 (2020) doi:10.48550/arXiv.2008.00893.

There is also a deep body of research supporting the concept of carbon flow tracing down to the nodal level, which is an extension of a well understood body of research on power flow tracing through transmission networks:

- Bialek, J. Tracing the flow of electricity. IEE Proc., Gener. Transm. Distrib. 143, 313 (1996).
- Kirschen, D., Allan, R. & Strbac, G. Contributions of individual generators to loads and flows. IEEE Transactions on Power Systems 12, 52–60 (1997).
- Bialek, J. W. & Kattuman, P. A. Proportional sharing assumption in tracing methodology. IEE Proc., Gener. Transm. Distrib. 151, 526 (2004).
- Kang, C. et al. Carbon Emission Flow in Networks. Sci Rep 2, 479 (2012). https://www.nature.com/articles/srep00479
- Kang, C. et al. Carbon Emission Flow From Generation to Demand: A Network-Based Model. IEEE Transactions on Smart Grid 6, 2386–2394 (2015). https://ieeexplore.ieee.org/document/7021901
- Wang, W., Huo, Q., Deng, H., Yin, J. & Wei, T. Carbon responsibility allocation method based on complex structure carbon emission flow theory. Sci Rep 13, 1521 (2023). https://www.nature.com/articles/s41598-023-28518-y

9. If applicable, describe the process or stakeholders/groups consulted as part of developing this proposal.

N/A

10. If applicable, provide any additional information not covered in the questions above.

N/A

Proposal Annex

GHG Protocol Decision-Making Criteria and Hierarchy

A. First, GHG Protocol accounting and reporting approaches shall meet the GHG Protocol accounting and reporting principles:
- Accuracy, Completeness, Consistency, Relevance, Transparency
- Additional principles for land sector activities and CO_2 removals: Conservativeness, Permanence, and Comparability if relevant
- (See table below for definitions)

B. Second, GHG Protocol accounting and reporting approaches shall align with the latest climate science and global climate goals (i.e., keeping global warming below 1.5°C). To support this objective (non-exhaustive list):
- Direct emissions reported in a company's inventory should correspond to emissions to the atmosphere. Reductions in direct emissions reported in a company's inventory should correspond to reductions in emissions to the atmosphere.
- Indirect emissions reported in a company's inventory should in the aggregate correspond to emissions to the atmosphere. Reductions in indirect emissions reported in a company's inventory should in the aggregate correspond to reductions in emissions to the atmosphere.

C. Third, GHG Protocol accounting frameworks should support ambitious climate goals and actions in the private and public sector:
- Accounting framework/s would enable organizations to pursue more effective GHG mitigation/decarbonization efforts as compared to the existing standards and guidance
- Accounting framework/s would better inform decision making by reporting organizations and their stakeholders (e.g. related to climate-related financial risks and other relevant information associated with GHG emissions reporting)

D. Fourth, GHG Protocol accounting frameworks which meet the above criteria should be feasible to implement for the users of the frameworks.
- For aspects of accounting frameworks that meet the above criteria but are difficult to implement, GHG Protocol should provide additional guidance and tools to support implementation.

GHG Protocol Accounting and Reporting Principles

Principle	Definition
Accuracy	Ensure that the quantification of GHG emissions (and removals, if applicable) is systematically neither over nor under actual emissions (and removals, if applicable), and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.
Completeness	Account for and report on all GHG emissions (and removals, if applicable) from sources, sinks, and activities within the inventory boundary. Disclose and justify any specific exclusions.

Consistency	Use consistent methodologies to allow for meaningful performance tracking of emissions (and removals, if applicable) over time and between companies. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.
Relevance	Ensure the GHG inventory appropriately reflects the GHG emissions (and removals, if applicable) of the company and serves the decision-making needs of users – both internal and external to the company.
Transparency	Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.
Conservativeness (Land Sector and Removals Guidance)	Use conservative assumptions, values, and procedures when uncertainty is high. Conservative values and assumptions are those that are more likely to overestimate GHG emissions and underestimate removals, rather than underestimate emissions and overestimate removals.
Permanence (Land Sector and Removals Guidance)	Ensure mechanisms are in place to monitor the continued storage of reported removals, account for reversals, and report emissions from associated carbon pools.
Comparability (optional) (Land Sector and Removals Guidance)	Apply common methodologies, data sources, assumptions, and reporting formats such that the reported GHG inventories from multiple companies can be compared.