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Research Paper

Addressing Fragmentations in Emissions Reporting: A Theoretical Study on the Alignment of ISO and GHG Protocols for Integrating Carbon Accounting and Reporting Frameworks

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ABSTRACT

Purpose: This study aims to develop a conceptual framework for aligning ISO standards and GHG Protocols in the context of carbon emissions accounting and reporting for reducing fragmentations in reporting standards. The study approaches to re-identify and refine areas of overlap, divergence and integration pathways between the two for achieving harmonization, greater consistency, better comparability and improved decision-making quality. **Design, approach and Methodology:** The study follows a theoretical research design to analyze key concepts of ISO standards and GHG Protocol frameworks, synthesize existing theories and develop theoretical argument for overlap, divergence and integration. Discourse analysis is applied for concept development and refinement of ISO and GHG Frameworks from relevant literature and understanding current state of fragmentation. Argument development is employed to identify integration pathways and solutions for fragmentation reduction and also to examine challenges preventing effective alignment of the two frameworks. Comparative analysis is used for comparing ISO and GHG Protocol frameworks with respect to approaches, key similarities and differences. **Findings:** We find that ISO and GHG Protocol frameworks mainly overlap on the fundamental definitions and concept of life cycle of products and systems but diverge significantly in practical implementation. Reporting fragmentation exists due to inconsistent definitions on how a product's carbon footprint is established, consolidation approaches for measuring and reporting greenhouse gas emissions, preparing carbon footprint inventory and treatment of Scope 3 emissions. Thus, harmonization is needed to coordinate action across regulatory frameworks, standardize disclosure requirements to a greater extent and support sector-specific implementations. Although evidence-based solutions exist for such purpose but institution-wise coordination and policy alignment is required to achieve wider adoption. **Originality/Value:** Alignment of ISO Standards and GHG Protocols in carbon accounting frameworks poses a critical challenge in contemporary climate policy and corporate sustainability reporting. With very few published studies observed to focus on integration pathways of sustainability reporting frameworks, this study provides important guidelines and future research scope for carbon accounting and reporting harmonization.

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Carbon accounting is an important tool for implementing global climate action and serves as the foundation for informed implementation of emissions reduction strategies, carbon markets and regulatory compliance. Carbon accounting and emissions reporting has emerged mainly due to rising global awareness of climate change thereby requiring organizations to manage and disclose their greenhouse gas emissions. This field has evolved significantly since the Kyoto Agreement of 1997, with carbon accounting becoming an indispensable component of sustainable business practices and policy compliance **(Csutora & Harangozó, 2017).** The Paris Climate Agreement further solidified carbon accounting as a critical tool for transnational law and policy evidence **(West, 2019)**. Various methodologies and frameworks currently exist, such as the Green House Gas Protocol and Carbon Disclosure Project that guide organizations in carbon accounting and reporting by enabling them to measure, report and audit their emissions following bottom-up, top-down and hybrid methodologies to quantify emissions at different organizational levels, thereby facilitating informed decision-making and strategic planning **(Csutora & Harangozó, 2017).** However, existence of different accounting standards and methodologies has created significant fragmentation in measurement, reporting and verification of greenhouse gas emissions by entities (**Graduate Institute of International and Development Studies**).

Therefore, there is a need for standardized emissions reporting procedures. Such need has evolved from multiple interacting forces like policy, markets, investors, professional bodies and corporate management needs. Various international treaties and trading systems require reliable accounting and verification methods **(The handbook of carbon accounting).** For this purpose, institutional investors and CDP has created a disclosure channel to incentivize corporate measurement and reporting. Also, Professional Accounting bodies issue standards to govern measurement, auditing and treatment of carbon assets/liabilities **(Csutora & Harangozó, 2017).** On the basis of these, companies adopt carbon accounting to identify hotspots, inform mitigation strategies and integrate emissions metrics into management systems **(Bhatia and Ranganathan, 2004)**.

Currently, two frameworks dominate the field of carbon accounting: the ISO series and related life cycle assessment (LCA) standards and the GHG Protocol developed by the World Resources Institute and World Business Council for Sustainable Development. Both frameworks provide consistent and credible approaches to GHG accounting. They reflect a growing global commitment to address climate change using standardized GHG Management and carbon footprint assessment. ISO 14064, developed in 2006, provides a framework for GHG inventories and verification, facilitating consistent auditing and best practices for organizations **(Wintergreen & Delaney, 2006).** In contrast, ISO 14067, published in 2013, focuses on the carbon footprint of products, offering guidelines for life cycle assessment and communication of carbon footprints **(Wu et al., 2015).** Together with the GHG Protocols, they enhance transparency and comparability in GHG reporting and carbon management. However, differences in origin, scope and implementation techniques have created fragmentation in emissions reporting **(Jia et. al., n.d.).**

Such fragmentation in carbon accounting frameworks create certain critical challenges:

1. Comparability Issues: Different methodological choices may lead to incomparable results across organizations and sectors
2. Decision-Making Barriers: Inconsistent reporting reduces the reliability of emissions data for policy and investment decisions
3. Compliance Complexity: Organizations may face multiple and conflicting requirements across different regulatory jurisdictions
4. Market Inefficiencies: Fragmented reporting undermines the effectiveness of carbon markets and climate finance mechanisms

Definition of the Research Problem

Although elaborate frameworks exist for standardizing carbon accounting and reporting, sustainability reporting is still in its nascent stages and gradually developing and presentation of reports by organizations is still mostly voluntary. BRSR is mandated by SEBI only for top 1000 listed companies by market capitalization. Also, there is no single referred measurement and reporting methodology for GHG emissions, consequently leading to divergent practices. Thus, there is a need to identify the areas of convergence and divergence in carbon accounting and reporting standards, challenges in convergence and suggesting the scope and channels for harmonization with respect to ISO standards and GHG Protocols.

REVIEW OF LITERATURE AND THEORETICAL BACKGROUND

Conceptual Framework

ISO 14064 and 14067 Standards

These two standards broadly focus on greenhouse gas emissions by providing internationally recognised guidelines for measuring and reporting carbon footprint. Implementing these standards can benefit an organisation by enabling them to improve energy efficiency, increase transparency and credibility, strengthening competitiveness and preparing them for future regulatory changes. ISO 14064 focuses on managing greenhouse gas emissions at an organisational level by supporting the measurement, reporting and reduction of these emissions in a company-wide context. ISO 14067, on the other hand, addresses the measurement of carbon footprint of products and enabling the analysis of emissions across the life cycle of a specific product. While ISO 14064 covers a broader organisational perspective, ISO 14067 focuses on specific impacts related to individual products.

ISO 14067 Standards: ISO 14067 focuses on the measurement and reporting of the lifecycle emissions of a product. It covers both direct and indirect emissions associated with all stages of the supply chain, including raw materials and consumables, distribution, consumption and disposal. It can be applied to both physical products as well as services, making it a versatile tool for sustainability.

Measuring a product's carbon footprint allows companies to identify emission-intensive processes and take action to optimise them, leading to cost reductions and increased operational efficiency. By following the ISO 14067, organisations can also benchmark their performance against others in the industry, which promotes increased competitiveness and innovation.

This standard supports better understanding of a company's impact on climate change as well as enabling them to develop strategies to reduce greenhouse gas emissions. As a result, companies can implement measures to improve energy efficiency, use renewable energy sources and introduce more sustainable practices throughout their supply chains.

ISO 14064 Standards: ISO 14064 focuses on the management of greenhouse gas (GHG) emissions at the organisation level. The standard has three parts, each focusing on a different aspect of emissions management. These are:

The carbon footprint of the organisation
The first part of the standard, ISO 14064-1, focuses on the organisational level, offering the creation of accurate GHG emissions statements. This part of the standard is crucial for increasing stakeholder confidence and for preparing organisations to comply with future environmental regulations. Properly prepared statements on this basis enable a more accurate understanding of an organisation's performance in terms of emission sources and the identification of areas with potential for improvement.

The carbon footprint of a project
The second part of the standard, ISO 14064-2, focuses on reduction projects, providing tools for planning, implementing and monitoring initiatives aimed at reducing emissions. By applying these guidelines, organisations can assess the effectiveness of their actions, leading to cost savings and improved operational efficiency.

Verification and validation
This part (ISO 14064-3) provides a framework for the verification and validation of emissions data and reduction projects. Such verification processes are essential to maintain the reliability of data and reports, which is key to building trust among stakeholders.

Together, these three parts of the ISO 14064 create a comprehensive framework for carbon footprint management system that supports organisations in their pursuit of sustainability and environmental responsibility.

Managing greenhouse gas emissions is key to the sustainability of any organisation. ISO 14064 and 14067 standards enable accurate measurement, reporting and optimisation of emissions, benefiting both companies and the environment. Implementing these standards is a step towards greater efficiency, transparency and environmental responsibility.

GHG Protocols
The GHG Protocols establishes a comprehensive, globally standardized framework to measure and manage greenhouse gas (GHG) emissions from private and public sector operations, value chains and mitigation actions. Its aim is to develop the most credible, accessible and widely used greenhouse gas accounting and reporting standards and to proactively facilitate their global adoption and implementation so that all private and public entities account for their GHG emissions, enabling an acceleration in emissions reductions in line with the global warming limits required by climate science.

GHG Protocol convenes multiple groups that guide the development of its accounting and reporting standards. Its multi-stakeholder governance process includes a Steering Committee, an Independent Standards Board and Technical Working Groups. GHG Protocol

supplies the world's most widely used greenhouse gas accounting standards. The Corporate Accounting and Reporting Standards provide the accounting platform for every possible corporate GHG reporting program in the world. In 2023, 97% of disclosing S&P 500 companies reported to CDP using GHG Protocol. Over the years, the GHG Protocols have developed a broader set of standards and tools designed to guide climate action across different sectors and use cases. This includes frameworks for corporate reporting, product life cycle accounting and even city-wide emissions tracking. Standards are regularly updated to reflect new climate science, policies, and industry practices. To make reporting easier and more accurate, the protocol also provides practical guidance documents, calculation tools and training programmes for organisations of all sizes.

The GHG Protocols categorises overall emissions of an entity into three types as follows:
Scope 1- Direct emissions: These are GHG emissions that come directly from sources a company owns or controls. It includes fuel combustion in company vehicles, manufacturing equipment, or on-site heating systems. If a company is burning fuel or releasing gases on-site, that is Scope 1.
Scope 2- Indirect emissions from energy use: Scope 2 refers to emissions that occur off-site but are tied to the energy a company purchases and consumes. This commonly includes emissions from the generation of electricity, steam, heating or cooling used in offices, factories or data centres.
Scope 3- Indirect emissions across the value chain: Scope 3 emissions are the most wide-ranging and often the most significant. They include all other indirect emissions that occur as a result of a company's activities but from sources not owned or directly controlled by the company. This can include the production of raw materials and transportation of goods to employee commuting, product use and end-of-life disposal.

This scope-based system allows organisations to clearly define the boundaries of their emissions reporting, ensure greater consistency and comparability across industries, making it easier to benchmark progress and identify where reductions will have the greatest impact.

GHG Protocols benefits organizations in the following ways:
Provides clarity on where emissions come from and how to reduce them:
The GHG Protocol helps organisations understand exactly where their greenhouse gas emissions originate across Scopes 1, 2, and 3. This enables more focused reduction efforts, whether it's improving operational efficiency, switching to renewable energy or redesigning supply chains.

Builds trust with investors, customers, and stakeholders
It enables transparent reporting and helps companies demonstrate accountability and credibility, especially in a scenario where 88% of institutional investors consider ESG factors in their decisions.

Aligns with ESG frameworks and global standards
The GHG Protocol is embedded in many leading sustainability initiatives, including Science Based Targets initiative (SBTi) – requiring Scope 1–3 reporting, Global Reporting Initiative (GRI) and SASB – using GHG Protocol principles and regulations such as the EU's SFDR and UK's SDR. Many ESG frameworks, like CDP and the Science Based Targets initiative, are built on GHG Protocol principles, but companies can also use the GHG Protocol directly to build emissions inventories and set science-based targets.

Prepares companies for compliance and climate risk disclosure
As governments introduce stricter reporting rules, including requirements for climate-related financial disclosures, the GHG Protocol provides companies with a consistent and auditable method for emissions reporting.

Drives product innovation and market opportunities
By measuring the full emissions impact of their products and services, companies can make more informed design, sourcing, and production decisions, often reducing both emissions and costs. This product-level insight also helps brands meet growing consumer demand for sustainability.

The Greenhouse Gas Protocol includes a collection of evolving standards designed to meet the diverse needs of organisations measuring and managing their emissions. It comprises of Corporate Accounting and Reporting Standards, Corporate Value Chain (Scope 3) Standards, Product Life Cycle Standards, Project Protocols, Global Protocol for Community-Scale GHG Emission Inventories (GPC), Mitigation Goal Standards and Policy and Action Standards.

Current Situation of Fragmentation in Emissions Reporting

1. Scale and Scope of Fragmentation

The fragmentation in carbon accounting exists in diverse areas, afflicting comparability and decision-making quality at micro and macro levels. Various researches have consistently pointed at system boundaries, allocation procedures and significant omissions in corporate disclosures **(Facilitating standardization in corporate greenhouse gas accounting).**

The significant areas of fragmentation are:

1. **Multiple Methodological Approaches:** Multiple standard-setting bodies are suggesting overlapping but not identical guidance, causing inconsistent boundary definitions and allocation rules across production techniques and product inventories **(Boakye et. al., 2023).**
2. **Gaps in Scope 3 Reporting:** Several corporate reports omit substantial portions of value-chain emissions, with large variations in what activities are included or excluded from Scope 3 calculations **(Mahto et. al., 2023)**.
3. **Divergent Consolidation Approaches:** Different organizations use different consolidation methods (equity share versus operational control versus financial control). Although operational control remains predominant but it affects reported totals and policy alignment **(Osorio et. al., 2022)**.
4. **Institutional Multiplicity:** Existence of parallel standard bodies create overlapping but misaligned reporting requirements, reinforcing fragmentation rather than convergence **(Osorio et. al., 2022)**.

2. Impacts of reporting fragmentations on Stakeholders

- **Corporate Reporting Challenges:** Cost of reporting and publishing increases due compliance to multiple reporting requirements. Multiple reporting standards limits the scope of benchmarking and proper performance assessment by stakeholders, thereby reducing comparability. This also affects strategic decision-making ability due to uncertainty in choosing proper methodology.

- **Regulatory and Policy Implications:** Parallel emissions reporting standards causes difficulty in arranging corporate data for national inventories. This causes problems in designing effective carbon pricing mechanisms and climate policy instruments.
- **Investment and Finance Sector:** Fragmented reporting standards restrict consistent assessment of climate risk and opportunities. This limits the designing of standardized climate finance products. Also, confidence in ESG reports and ratings also fall due to non-existence of unified standards.

3. Quantitative Evidence of Fragmentation

Several studies have discovered quantitative evidence of the scale of fragmentation. Scope 3 reporting of corporations have shown omission rates of 30-70% of value-chain emissions across sectors **(Mahto et. al., 2023).** Also, variations in choosing consolidation method resulted in 20-40% differences in reported emissions for the same organization **(Osorio et. al., 2022).** Further, inconsistent boundary definition has led to non-overlapping results in 40-60% of comparative studies **(Jia et. al., n.d.).**

Objectives of the Study

The current study aims to achieve the following objectives:

- Compare ISO 14064 and 14067 standards with GHG Protocols to identify key similarities and differences.
- Analyse the areas of convergence and divergence in carbon accounting and emissions reporting and examine the challenges preventing effective alignment.
- Identify the best practices and provide evidence-based solutions to reduce fragmentations and achieve effective harmonization.

RESEARCH METHODOLOGY

Research Design

This study uses an exploratory research design. It aims to identify and justify the areas of converge and divergence in carbon accounting and emissions reporting practices in the context of ISO 14064 and ISO 14067 and GHG Protocols. A qualitative and theoretical approach is undertaken to achieve the research objectives.

Resources applied from Published Literature

The ISO 14064 and 14067 standards and the GHG Protocols serve as the theoretical base for the analysis. Theoretical resources in the form of arguments, research insights, observations and evidences have been obtained from observed literature. Observations of past studies used for the analysis have been collected from Google Scholar, Sci-Hub, Research gate and other accessible databases. The theoretical content is then structurally arranged for further analysis.

Analysis

The theoretical content obtained from the standards, protocols and other literary sources have been first organized in a systematic manner. A qualitative comparative analysis has been used to point out the areas of similarities and differences between the ISO standards and GHG Protocols. From such similarities and differences, the existing areas of convergence, the possible scope for harmonization and the areas of complete divergence have been chalked out. Discourse analysis has been applied to refine and solidify the conceptual backbone of the theoretical proposals. It has also been used to build a clear understanding of the current state of reporting fragmentations. Finally. identification of the

pathways for integrating the two frameworks, forming solutions for fragmentation reduction and proper examination of the challenges preventing effective alignment has been done by constructing an efficient argument development.

ANALYSIS AND FINDINGS

Comparative Analysis of ISO Standards and GHG Protocols

Table 1: Detailed Comparison Matrix (Source: Author's illustration)

Aspect	GHG Protocol	ISO 14064 & 14067 (LCA Family)
Primary Purpose	Corporate and product oriented GHG accounting guidance concentrating on inventories and disclosures, with specified Scope 1,2 and 3 emissions frameworks **(Osario et. al., 2022).**	Standards for quantification, management systems and life-cycle assessment supporting measurement and verification across organizations and products **(Jinying and MacAskill, 2024).**
Boundary Treatment	Operationalized Scope 1/2/3 framework based on operations. Specific guidance on value-chain reporting **(Osario et. al., 2022).**	Life-cycle perspective is fundamental; ISO 14064 aligns definitions with corporate GHG concepts but emphasizes technical quantification and systems **(Jinying and MacAskill, 2024).**
Verification Approach	Practical guidance for consistent corporate disclosure; widely used in regulatory and voluntary reporting contexts **(Osario et. al., 2022).**	Normative requirements for quantification and verification; often used as technical basis for audits and certifications **(Jinying and MacAskill, 2024).**
Methodological Detail	Focuses on practical implementation with sector-specific guidance.	Emphasizes technical rigor and systematic approaches to measurement.
Institutional Context	Developed for corporate sustainability reporting and carbon markets.	Developed as international standards for quality management and technical specifications.

From such comparison, the areas of convergence and divergence identified by the study are as follows:

Areas of Convergence of the two Reporting Frameworks

1. **Definitional Alignment:** This study observes that ISO definitions and Life Cycle Assessment methods are effectively mapped to GHG Protocol scopes with organizations commonly applying both frameworks together when preparing comprehensive inventories **(Jinying and MacAskill, 2024), (Lydgate and Zhao, 2025).**

2. **Practical Integration:** Frequent pairing of frameworks has been observed in sector-specific areas and UN guidance that explicitly aligns ISO and GHG Protocol elements for Scope 3 emissions reporting roadmaps **(Lydgate and Zhao, 2025).**
3. **Technical Compatibility:** The core measurement principles, emission factor approaches and data quality requirements show substantial overlap between frameworks **(Blumberg and Sibilla, 2023).**

Areas of Divergences of the two Reporting Frameworks

1. **Consolidation Approaches:** We see that the GHG Protocol provides explicit guidance on organizational boundary consolidation methods while ISO focus primarily on measurement accuracy rather than consolidation rules **(Osario et. al., 2022).**
2. **Scope 3 Emissions Treatment:** Levels of prescriptiveness in value-chain boundary setting are found to differ, leading to varying implementation outcomes **(Mahato et. al., 2023).**
3. **Verification Requirements:** ISO standards emphasize formal verification processes while GHG Protocol allows for more flexible assurance approaches **(Alaoui et. al., 2024).**

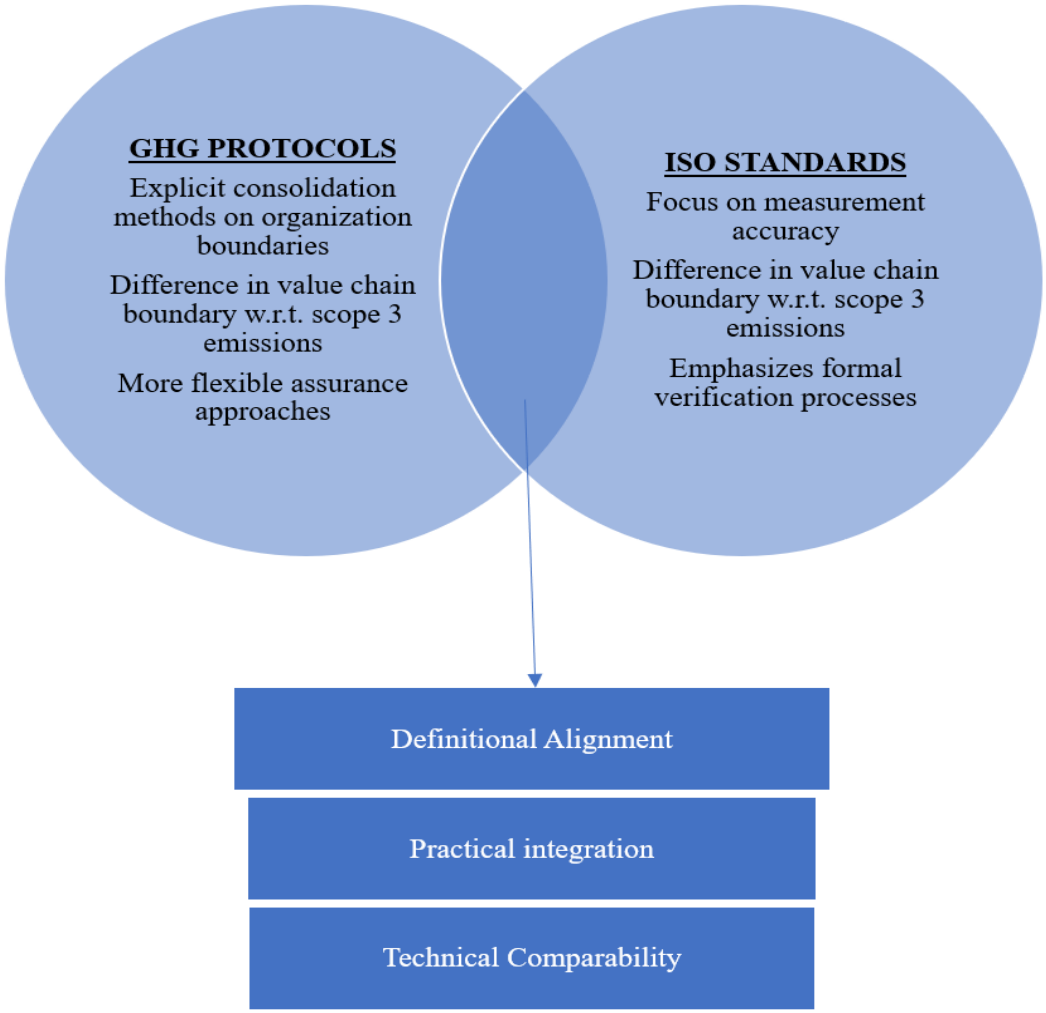

Figure 1: Venn diagram showing Convergence and Divergence areas of ISO Standards and GHG Protocols. (Source: Authors' illustration)

Challenges in Achieving Alignment in Frameworks

The main challenges observed by this study are categorized as follows:

Methodological Challenges

- **Scope 3 Complexity:** We identify the treatment of value-chain emissions as the most significant alignment challenge as different guidance documents treat boundary choices and activities to be excluded differently, resulting in large omissions in corporate footprints and reducing comparability across organizations **(Mahato et. al., 2023).**
- **Data Quality and Availability:** We see that alignment efforts face substantial data infrastructure challenges. This is majorly due to limited availability of standardized data owing to heterogeneity in operational nature and activities among different sectors. Automated alignment also becomes complicated as requirements for life-cycle data differs across standards. This also results in limited number of high-quality emission factors for emerging technologies and services **(Huckins, 2024).**

Institutional and Governance Barriers

- **Presence of multiple Standard setting bodies:** Existence of multiple standard-setting bodies creates overlapping but not identical requirements, blocking the development of a unified implementation path **(Xu et. al., 2024).**
- **Regulatory Fragmentation:** Different national and regional regulatory approaches to carbon accounting create additional complexity. EU taxonomy requirements differ from US SEC climate disclosure rules. National inventory guidelines may clash with corporate reporting standards. Carbon market requirements create further methodological constraints. This makes homogenous reporting a difficult feat to achieve both in the Indian as well as the international context **(Augoye et. al., 2024).**

Challenges in Technical Implementation

- **Accounting Policy Options:** We observe that the GHG Protocol's consolidation method choices produce materially different reported totals and coordinate with ISO approaches in complex ways, creating uncertainty in proper implementation **(Osario et. al., 2022).**
- **System Integration:** Technical barriers to alignment involve various systemic difficulties such as incompatible data schemes between Life-Cycle Assessment tools and corporate inventory systems, limited comparability between verification platforms and mapping problems between different emission factor databases **(Huckins, 2024).**

Risk of Divergent Interpretation

Based on recent reviews focussing on greenwashing and inconsistent interpretation of guidance documents, we see that they result in creating risk for multiple model choices without mandatory transparency requirements **(Stridsland et. al., 2023).**

Suggested Solutions for Fragmentation Reduction

We suggest the following solutions for reducing emissions reporting fragmentations.

Clear Boundary Mapping

Implementation Approach: Explicit mapping documents may be developed that can translate GHG Protocol scopes and consolidation choices into ISO-compatible boundary statements to avoid double counting and omissions **(Lydgate and Zhao, 2025).**

Evidence Base: Based on significant studies, systematic boundary mapping may be used to reduce interpretation variance, reportedly by 30-50% as observed in comparative assessments. This result can be applied practically to create standardized templates for boundary definition, develop decision trees for consolidation method selection and implement automated consistency checks across reporting systems **(Lydgate and Zhao, 2025).**

Enhancement in transparency and disclosure mechanisms

Standardized Disclosure Checklists: As observed by the study, comprehensive disclosure checklists may be used, which can cover scope, data sources and activity exclusions to improve comparability. We have observed that systematic transparency requirements have demonstrated effectiveness in improving reporting quality with reference to mandatory disclosure of methodological choices, standardized uncertainty reporting, clear documentation of exclusions and limitations and consistent treatment of bio-emissions **(Blumberg and Sibilla, 2023).**

Harmonization Frameworks

Corrective Mechanisms: This study suggests that harmonization frameworks can be applied to adjust for reporting inconsistencies, boundary incompleteness and activity exclusions when aggregating corporate reports, particularly for Scope 3 emissions. Examples include development of adjustment factors for different consolidation approaches, standardized extrapolation methods for incomplete value-chain data and consistent treatment of joint ventures and partnerships **(Mahto et. al., 2023).**

Sector-Specific Implementation

Sectoral Roadmaps: We observe that sector-specific measurement and management processes can be developed to standardize activity data, emission factors, and allocation rules. Sector roadmaps are seen to reduce interpretation variance significantly. The success of such process depends on the degree of industry collaboration in developing sector-wise guidance, integration with existing industry reporting frameworks, extent of regular updates to reflect technological changes and alignment with regulatory requirements **(Alaoui et. al., 2024), (Lydgate and Zhao, 2025).**

Technical Comparability

Data Infrastructure Development: Core data schemas and emission-factor libraries can be standardized to facilitate data exchange between Life Cycle Assessment tools, corporate inventory systems, and regulatory disclosure platforms. This requires a common data exchange format, standardized emission factor databases, interoperable verification platforms and automated consistency checking tools **(Huckins, 2024), (Xu and MacAskill, 2024).**

We suggest a roadmap using all the above observations for harmonization procedures, that may be implemented for integrating carbon accounting and emissions reporting standards and reducing fragmentations.

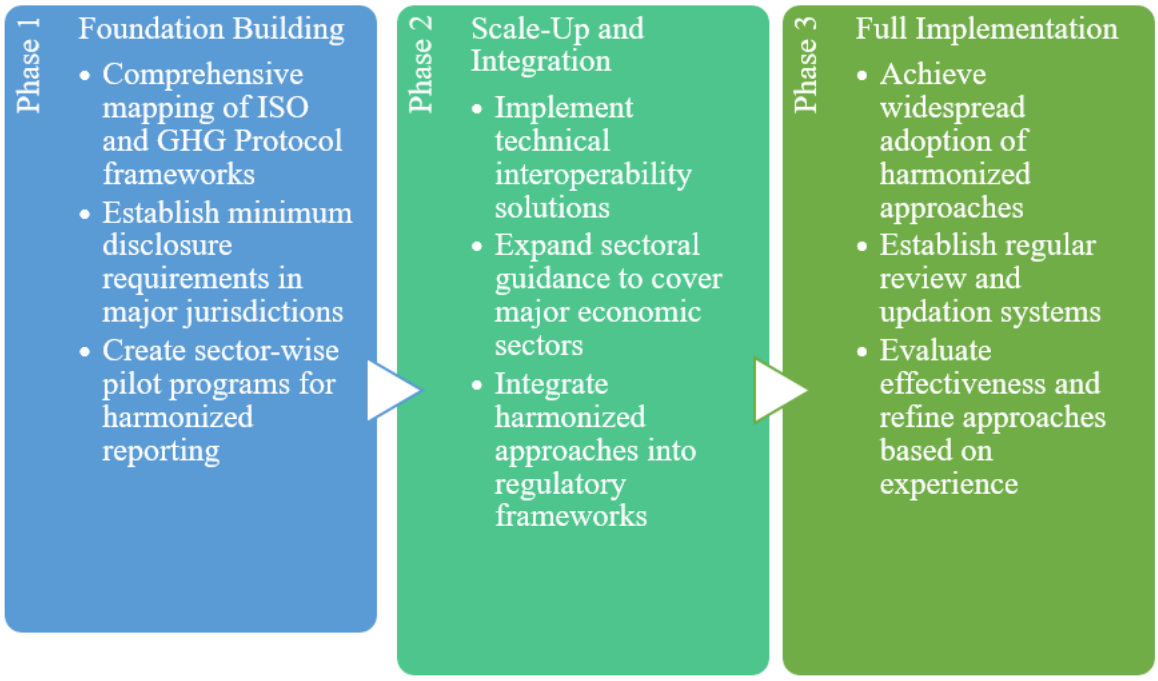

Figure 2: Flowchart showing detailed implementation of proposed harmonization procedure. (Source: Authors' illustration)

Additionally, we suggest the following measures that may be adopted to evaluate the degree of success of the harmonization process:

Quantitative Measures:

- Reduction in reporting variance across organizations using different frameworks
- Increase in Scope 3 reporting completeness
- Improvement in data quality scores
- Reduction in compliance costs

Qualitative Measures:

- Stakeholder satisfaction with reporting consistency
- Regulatory acceptance of harmonized approaches
- Market confidence in carbon accounting data
- Effectiveness in supporting climate policy objectives

CONCLUSION AND SUGGESTIONS

The alignment of ISO standards and GHG Protocol in carbon accounting frameworks represents a significant challenge as well as a critical opportunity for improving the effectiveness of global climate action. Considering the substantial fragmentation currently existing in emissions reporting, this study reveals the practical solutions that may be availed to meaningfully progress toward harmonization. The key conclusions summarised by this study are as follows:

- **Convergence is Possible:** We see that ISO and GHG Protocol frameworks show substantial overlap in fundamental definitions and measurement principles, providing scope for practical alignment.
- **Pragmatic Approach Required:** Rather than attempting a complete merger of frameworks, evidence found by the study supports a pragmatic harmonization strategy focusing on mapping, transparency, sector-specific guidance and regulatory alignment.
- **Implementation Focus Needed:** The primary barriers observed to alignment are implementation-related rather than fundamental conceptual differences, suggesting that coordinated action can achieve significant progress.
- **Stakeholder Coordination Essential:** It is seen that success requires coordinated action across standard setters, regulators, industry groups, and technology providers.

This study suggests pragmatic harmonization as the viable path forward, emphasizing the need for clearer boundary rules, enhanced transparency requirements, sector-specific implementation guidance and coordinated regulatory approaches **(Lydgate and Zhao, 2025), (Mahto et. al., 2023), (Alaoui et. al., 2024), (Osorio et. al., 2022).** While insufficient evidence exists to support a complete merger of ISO and GHG Protocol frameworks, the substantial overlap in core concepts and the availability of proven harmonization techniques provide a realistic foundation for reducing fragmentation and improving the quality of emissions reporting.

Recommendations and directions for future research

Future studies may focus on the mandatory elements for minimum disclosure elements, specifically boundary choices, consolidation approaches and main activity exclusions that may be implemented for comparability across submissions **(Alaoui et. al., 2024), (Osorio et. al., 2022).** Promotion of Meta-Standards and Mapping Guidance that translates between ISO LCA, ISO 14064 terms, and GHG Protocol for corporate and product standards to reduce interpretive gaps require further attention **(Lydgate and Zhao, 2025), (Xu and MacAskill, 2024).** Also, coordination of international forums (G20, UNFCCC, OECD) to fund harmonization projects and endorse comparable norms that align ISO and GHG Protocols requires further study **(West, 2019), (Osorio et. al., 2022).**

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Conflict of Interest

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